

Trouble-shooting instructions : POR-5013

BOSCH system : ABS

Make of vehicle : PORSCHE

Basic microcard : PKW-040

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SPECIAL FEATURES

This microcard, valid at the time of publication, contains trouble-shooting instructions for the following models:

PORSCHE 928 S
08.1987 ->

- * ABS with 4 wheel-speed sensors and 3 hydraulic channels.
- * Sensor ring gear with 45 teeth.
- * Vehicles with tire-inflation-pressure monitoring system (RKS) are provided with wheel-speed-sensor signals conditioned by the ABS controller. Refer to SIS for RKS for testing these signals.

STRUCTURE, USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

For a detailed description of trouble-shooting, see the basic instructions.

ATTENTION :
The set values, terminal assignments and special features of these vehicle-specific brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

- * For safety reasons, the hydraulic modulator must not be repaired, but be exchanged as a complete unit.
Exception: relays.
- * Do not loosen any screws on the hydraulic modulator!
Danger of fatal accident due to brake failure.
- * Caution when handling brake fluid.
Poisonous!

For further information, see basic instructions.

TEST REQUIREMENTS FOR TESTING WITH ABS2 LED TESTER

- * Regulatory tire size fitted?
- * Check for firm seating of ground of return-supply pump.
- * Check for firm seating and corrosion of ground of overvoltage-protection relay term. 31.
- * Check for firm seating of ground strap between engine block and vehicle frame.
- * Check for leaks in hydraulic connections at hydraulic modulator and sealing points (visual examination).
- * If the ABS warning lamp lights up intermittently when driving (e.g. after switching on loads) and goes out again by itself, check the battery and power supply (alternator, regulator and voltage drops).
- * If the ABS warning lamp lights up constantly and does not go out, check the following points:
 - Controller plug sitting correctly on controller and latched?
 - All plug contacts O.K.?
 - Spring contacts latched?
 - Check installation position for correct seating of seal ring in controller plug, rounded side downward.

- Check wheel-speed-sensor leads for correct assignment at controller plug:

Wheel-speed sensors:

front left to term. 6 and term. 4.
front right to term. 11 and term. 21.
rear left to term. 8 and term. 9.
rear right to term. 24 and term. 26.
rear axle to term. — and term. —.

- V-belt snapped?
(Alternator provides no voltage, charge-indicator lamp and ABS warning lamp light up).
- * Connect ABS 2 LED tester to ABS wiring harness.
- Disconnect and connect controller only with ignition switched off.
- For testing, switch on ignition in all program-selector-switch positions (tester operates with current supply from vehicle battery).
- Observe LED (green) for current supply in all program-selector-switch positions.

C A U T I O N !

Do not drive with tester connected!

The brake system must be bled of air before the ABS test. Do not activate the ABS tester while the system is being bled.

Repeat the complete test program after any repairs are carried out.

The Antiskid System is a vehicle safety system.

Work on the system demands detailed knowledge of the system.

The conventional brake system must be O.K.

General information for trouble-shooting:

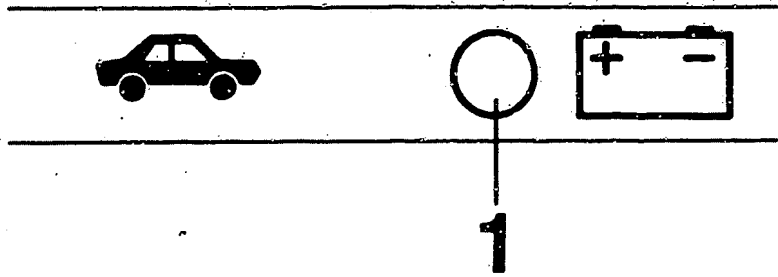
Check all leads for short circuit to ground and contact with positive leads and watch out for worn cable insulation and pinched leads.

RAPID DIAGNOSIS CHART

Never drive with tester connected! Have all test prerequisites been met?

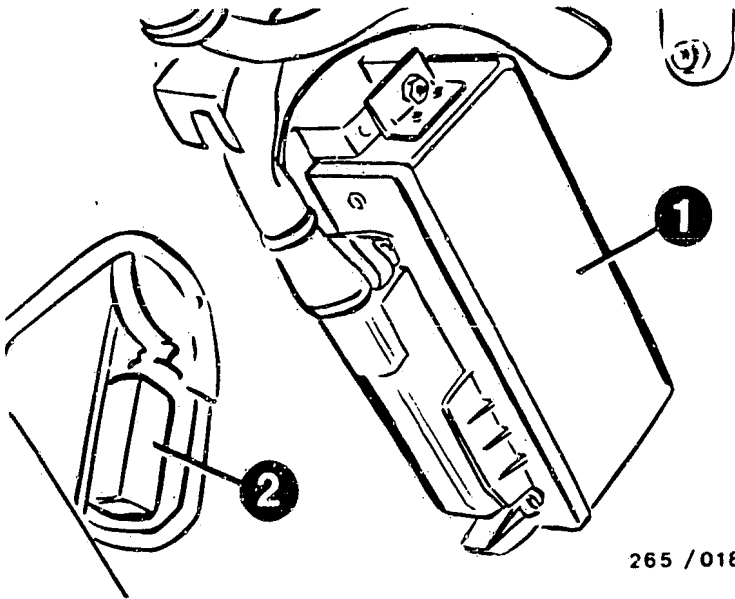
Program-selector-switch settings 1 - 6

Testing of (measurement at terminals)	Additional operation	Test speci- fication (indication)	Possible causes of trouble
Voltage supply (Term.1 and term.20)	Ignition on	LED 1 (top picture) lights up constantly	<ul style="list-style-type: none">* Fuse defective.* Inadequate battery charge.* Excessive voltage dips.* Check leads from relay plug to controller term. 1, to driving switch term. 15, to battery B+ and to ground terminal. Check ground lead to controller term. 20.* Over-voltage protection relay defective.



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1 = ABS controller
2 = Hood release mechanism

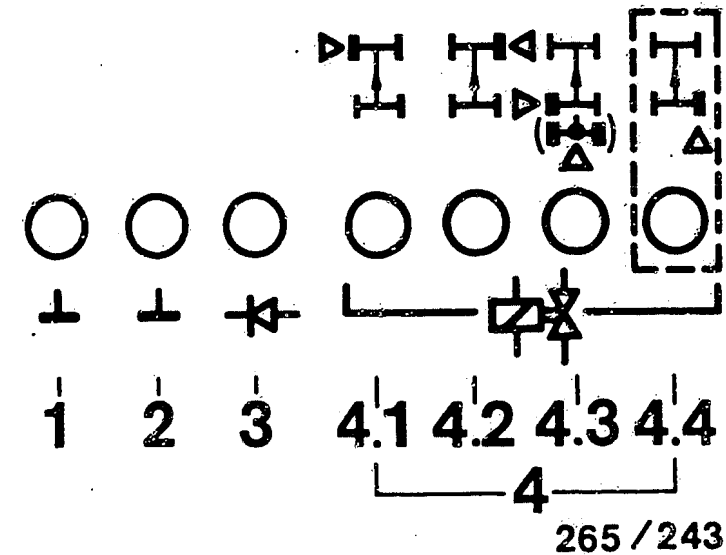


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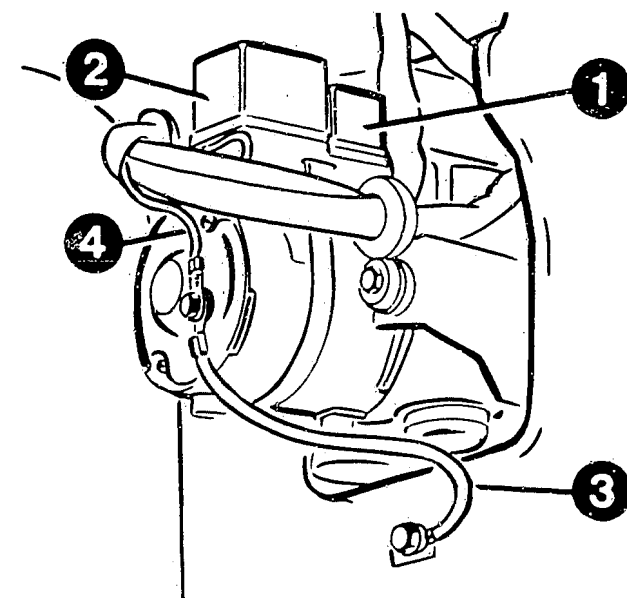
RAPID DIAGNOSIS CHART (CONTINUED)

Program-switch position 1 (3-channel hydraulic modulator)

Testing of (measurement at terminals)	Addition- al operation	Test specifi- cation (reading)	Possible causes of faults
Ground connection (term.10, term.34) Diode for warning lamp (term.29, term.32) Solenoid-operated valve internal res. (term.2, term.18, term.-, term.35) Off-position and ground connection of relay ABS warning lamp	Ignition on	6 LED (1 to 4.3) simultaneously brightly lit (top picture) ABS warning lamp in vehicle must light up	<ul style="list-style-type: none">* LED 1 and/or 2 (top picture) not lit: Check ground terminals for open circuit.* LED 3 (top picture) not lit: Diode defective, check ground connection of valve relay.* One or more LEDs 4 not lit: Check corresponding plug-in connection for solenoid-operated valve and leads.Solenoid-operated valve internal resistance 0,7...1,7 Ω* All LEDs 4 and LEDs 3 not lit: Check ground connection of valve relay, valve relay defective.* Dimmer lighting-up of an LED means contact resistance in the corresponding circuit.* ABS warning lamp not lit: Warning lamp defective. Note: all other 5 LEDs lit.



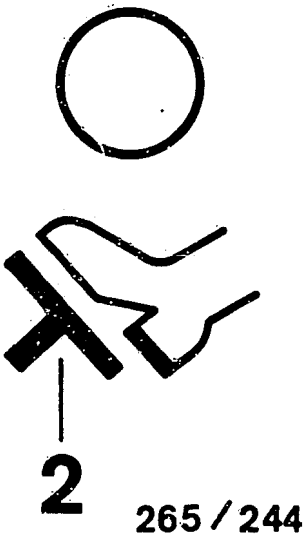
- 1 = Valve relay
- 2 = Motor relay
- 3 = Ground connection, return pump
- 4 = Ground connection, valve relay (if provided).



RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 2

Under test (Measurement at the terminals)	Addition- al operation	Test specifi- cation (reading)	Possible causes of trouble
Alternator voltage from term. 61/D+ (term. 15)	Ignition on	LED 1 (top picture) lit.	* In some cases, LED does not go out until after burst of throttle (test is O.K. in this case).
	Start engine	LED 1 (top picture) goes out when engine running	* Test lead and signal from alternator term. 61 * Alternator defective.
Stop-lamp switch (term.25)	Ignition on	LED 2 (top picture) lit	* Stop-lamp switch defective. * Check lead to stop-lamp switch.
	Press brake pedal	LED 2 (top picture) goes out	* Lead incorrectly connected to to stop-lamp switch.

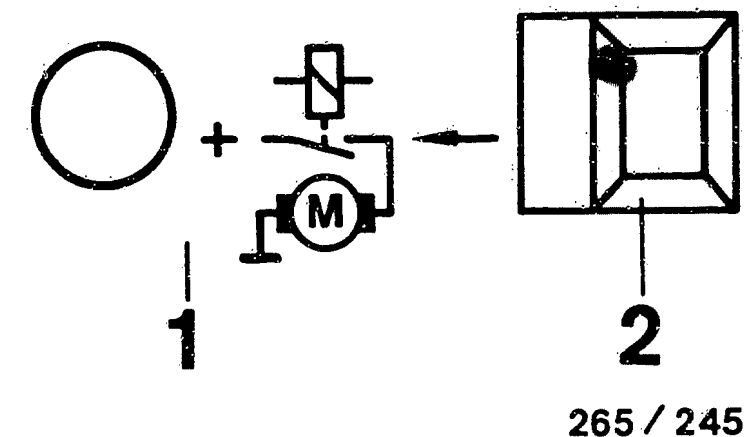


RAPID DIAGNOSIS CHART (CONTINUED)

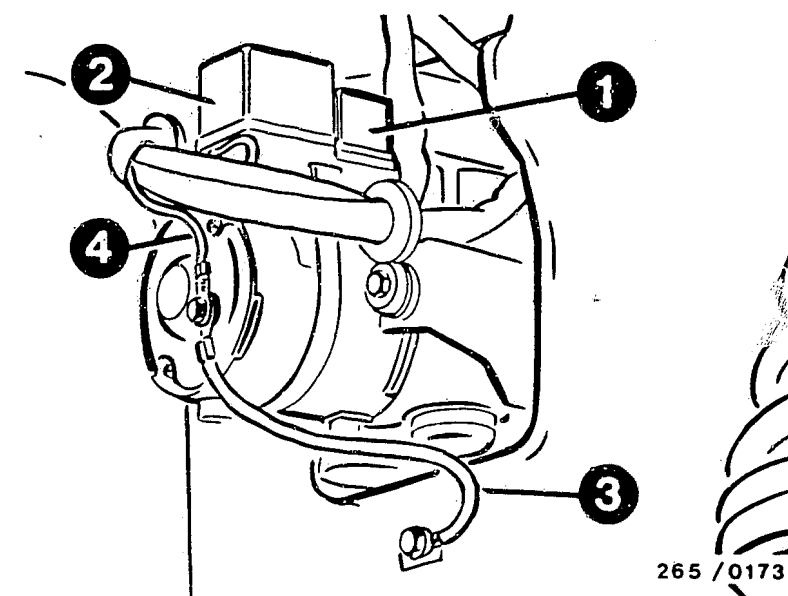
Program-selector-switch position 3

Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
Motor relay, pump motor in hydraulic modulator (term.14 and term.28)	Ignition on, press button 2 contin- uously (top picture)	LED 1 lights up, pump motor runs. After releasing button, LED con- tinues to light due to run-on of motor (top picture).	<ul style="list-style-type: none"> * Motor relay defective * Test ground connection and positive terminal of pump motor * Test following leads: From controller term. 14 and term. 28 to hydraulic modulator term. 9 or term. 11. Positive leads to hydraulic modulator term. 10 and term. 12. * Pump motor or hydraulic modulator defective.

Program-selector-switch position 4 does not apply.

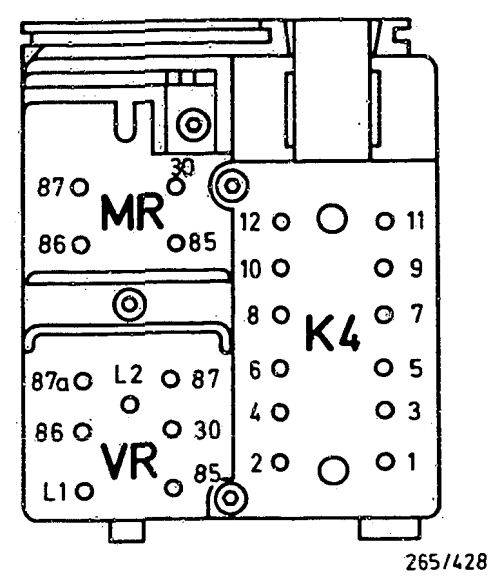
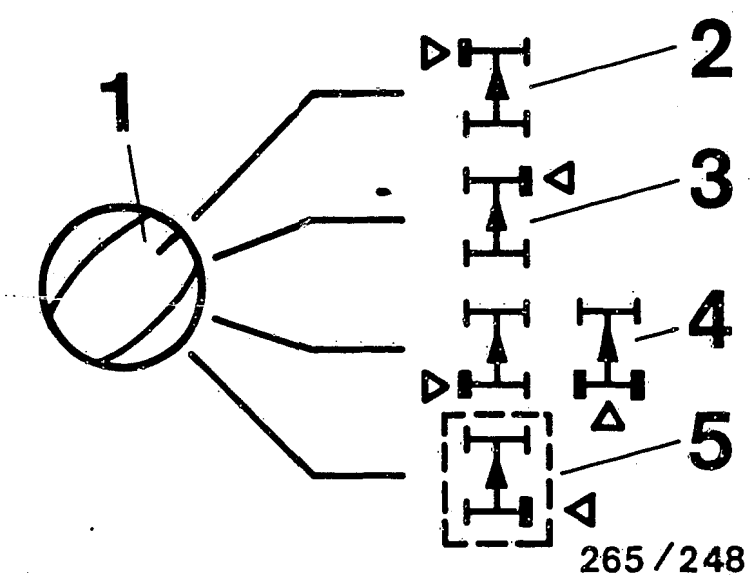
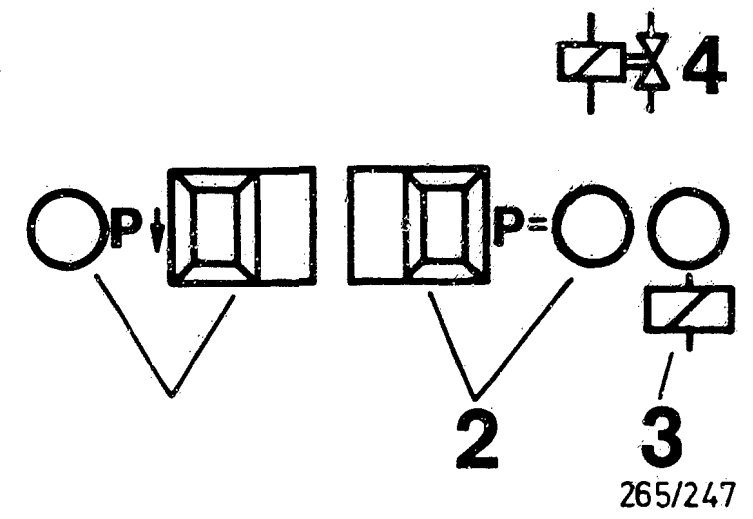


- 1 = Valve relay
- 2 = Motor relay
- 3 = Ground connection, return pump
- 4 = Ground connection, valve relay (if provided).



RAPID DIAGNOSIS CHART (CONTINUED)
Program-selector-switch position 5 (3-channel hydraulic modulator)

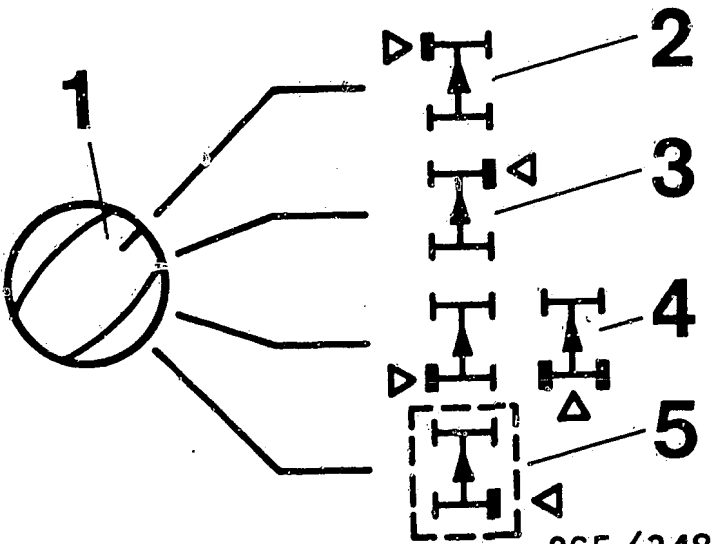
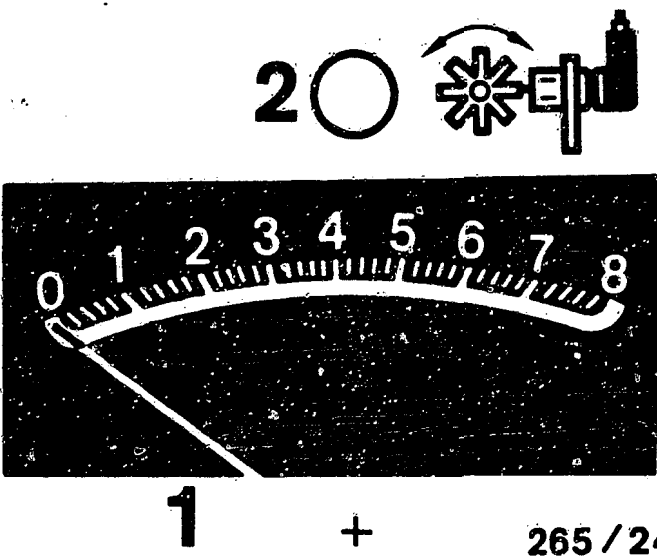
Test (measurement at terminals)	Additional operator action	Test specification (indication)	Possible fault causes
Valve-relay operation (term. 27)	Ignition on	LED 3 (upper illustration) lights up	* Valve relay (winding) or leads defective
Operation of solenoid valves in hydraulic modulator and connection correct way round. NOTE: Perform test consecutively for each wheel individually. Keep to operational sequence.	Jack up vehicle. Switch on ignition. You must be able to turn wheel under test freely by hand. Set switch 1 for wheel selection to the wheel under test. For rear axle, set to pos.4 (center illus.).		* Repeat test with engine running * Valve relay (working contact) defective * Open circuit in lead from valve relay term. 87 to B+ * Brake lines on hydraulic modulator mixed up
Pressure-holding function	1. Hold button P= (upper illus.) constantly pressed	LED P= (upper illus.) lights up	* Current value not reached (LED P arrow or P= go out; upper illustration): Battery inadequately charged. Repeat test with engine running.
	2. Hold brake pedal down constantly	Wheel can be turned by hand	
	3. Release button P= (upper illus.)	LED P= goes out (upper illus.) Wheel blocked	
Pressure-reduction function	4. Press button P arrow (upper illus.)	LED P arrow (upper illus.) lights up, wheel can be turned by hand	* Electrical connections of solenoid valves correct? Wheel front left: term.2 Wheel front right: term.35 Wheel rear left: term.- Wheel rear right: term.- Rear axle: term.18 * Hydraulic modulator defective
	5. Release button P arrow (upper illus.)	LED P arrow (upper illus.) goes out, wheel blocked	
	6. Release brake pedal		



RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 6 (4 wheel-speed sensors)

Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
Wheel-speed sensor for operation and mix-up NOTE: Check each wheel separately in turn. Wheel, front left: term.4 and term.6 Wheel, front right: term.11 and term.21 Wheel, rear left: term.8 and term.9 Wheel, rear right: term.24 and term.26	Chock-up vehicle. Ignition on. The wheel being tested must be freely turn- able by hand. When testing the driven axle, the wheel not being tested must be locked. Set switch for wheel selection to wheel to be tested (lower illustration) Turn wheel by hand until LED 2 above instrument lights up without flickering. (Wheel speed approx. 1 revolution per second). Afterwards, read off indication at instrument: (upper illustration)	1. Smallest reading larger 1,6 divisions 2. Permissible fluctuation max. 25 % of largest reading.	*Wheel-speed-sensor lead mixed up *Brake in wheel-speed- sensor lead *Wheel-speed sensor defective Winding resistance Front axle: 0,6...1,6 k Ω Rear axle: 0,6...1,6 k Ω *Air gap between wheel- speed sensor and ring gear too wide *Ring gear defective (e.g. corroded, dirty) or loose. *Ring gear with incorrect number of teeth installed Front axle: 45 teeth Rear axle: 45 teeth *Wheel-bearing clearance too large *Instrument gives reading, LED 2 does not light up: loose contact in wheel- speed sensor lead.



TEST SPECIFICATIONS

Wheel-speed sensor

* Winding resistance at ambient temperature (-10°C...+120°C) for front wheels:	600...1600 Ω
rear wheels:	600...1600 Ω

Hydraulic-modulator solenoid valves

* Winding resistance at ambient temperature (-10°C...+120°C):	0,7...1,7 Ω
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Air gap between wheel-speed sensor and ring gear

* at front wheels:	0,8 ± 0,5 mm
* at rear wheels:	0,8 ± 0,5 mm

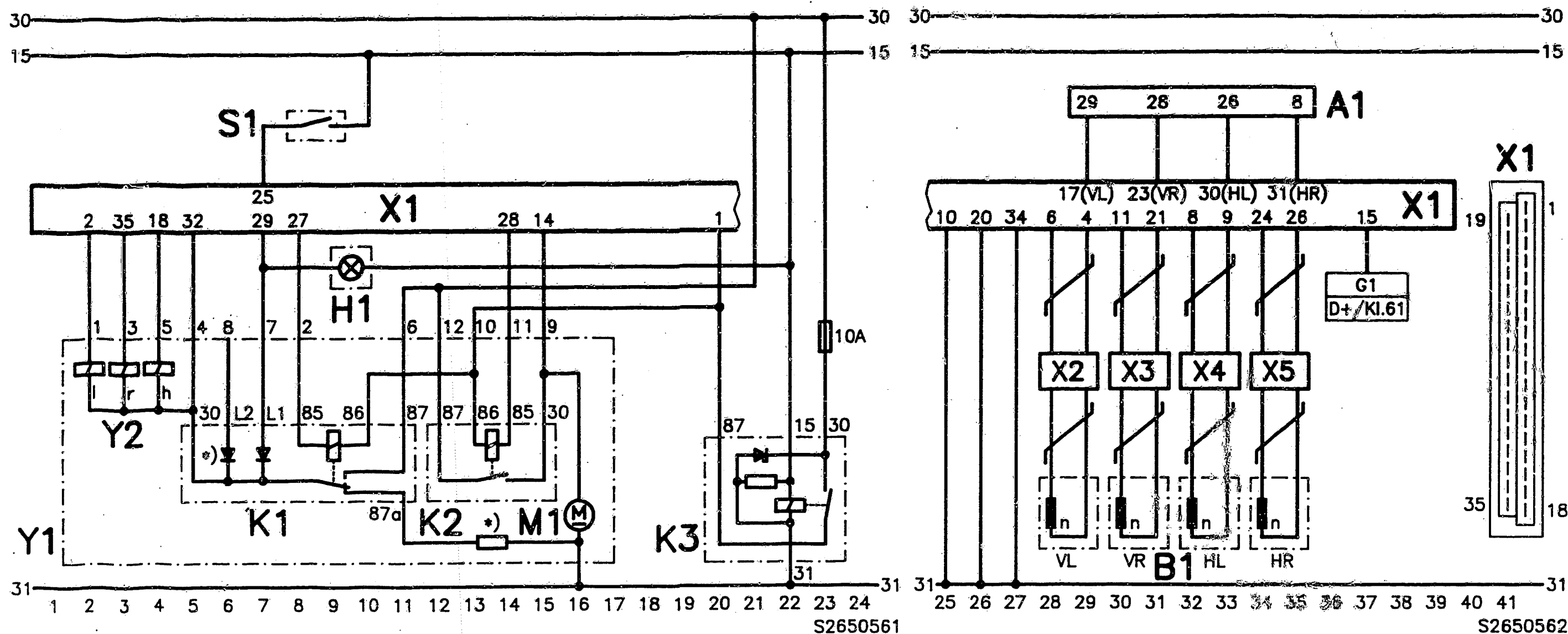
Tightening torque for

* fastening screws of wheel-speed sensors:	> 8 Nm
* Brake-line connections at hydraulic modulator:	12...16 Nm

Number of teeth on ring gears of wheel-speed sensors

* at front wheels:	45 teeth
* at rear wheels:	45 teeth

For production reasons:
continued on the following
coordinate.

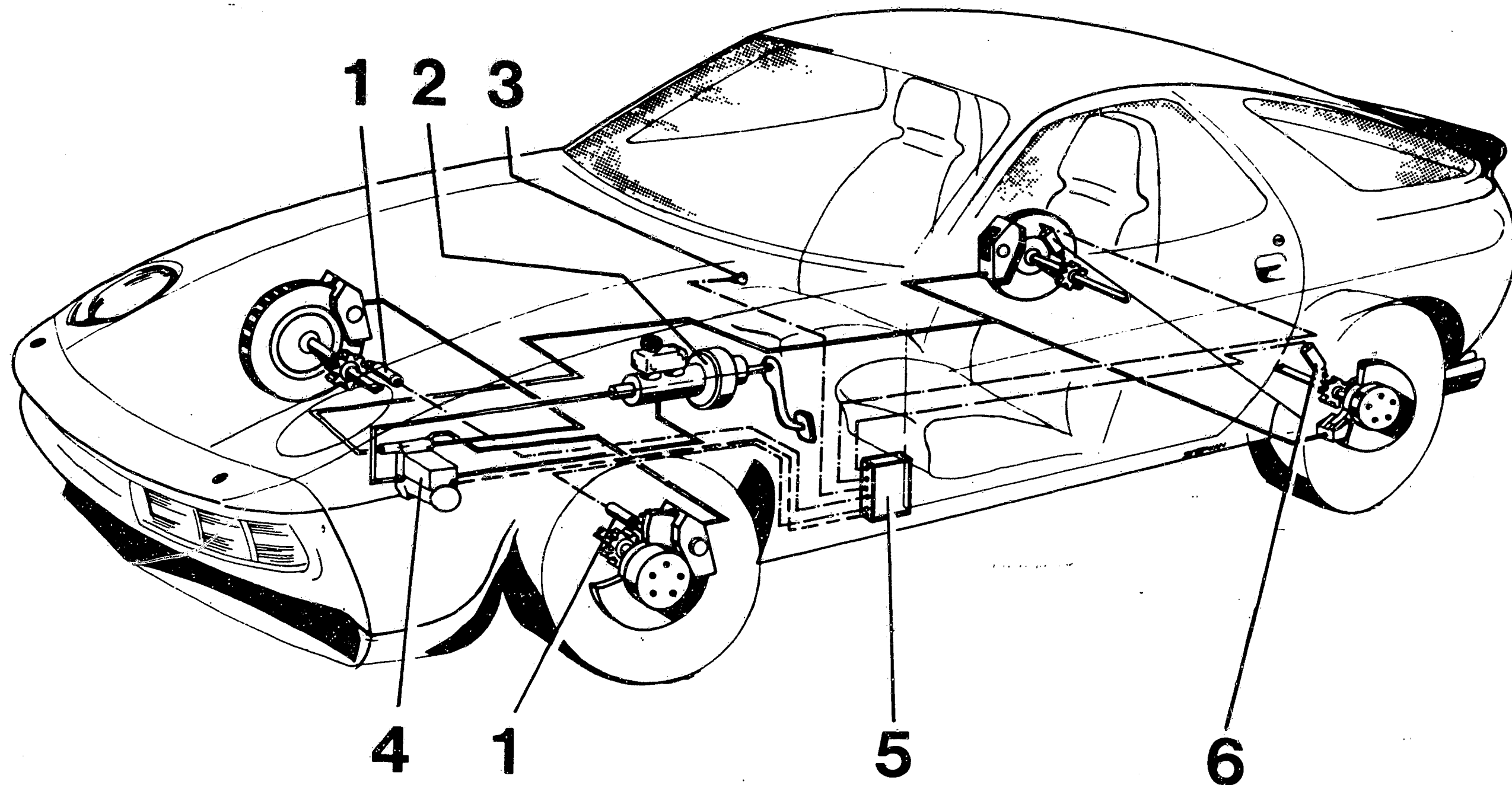


ELECTRICAL TERMINAL DIAGRAM

A1 = Tire-inflation-pressure monitoring system (if provided)
 B1 = Wheel-speed sensor
 G1 = to alternator
 H1 = ABS warning lamp
 K1 = Valve relay
 K2 = Motor relay

K3 = Over-voltage protection relay
 M1 = Return pump motor
 S1 = Stop-lamp switch
 X1 = Controller plug (35-pole)
 X2...X5 = Wheel-speed-sensor plugs
 Y1 = Hydraulic modulator
 Y2 = Solenoid valves

h = Rear axle
 HL = Rear left
 HR = Rear right
 VL = l = front left
 VR = r = front right
 *) = Hydraulic modulator designed for ETC (lock control)

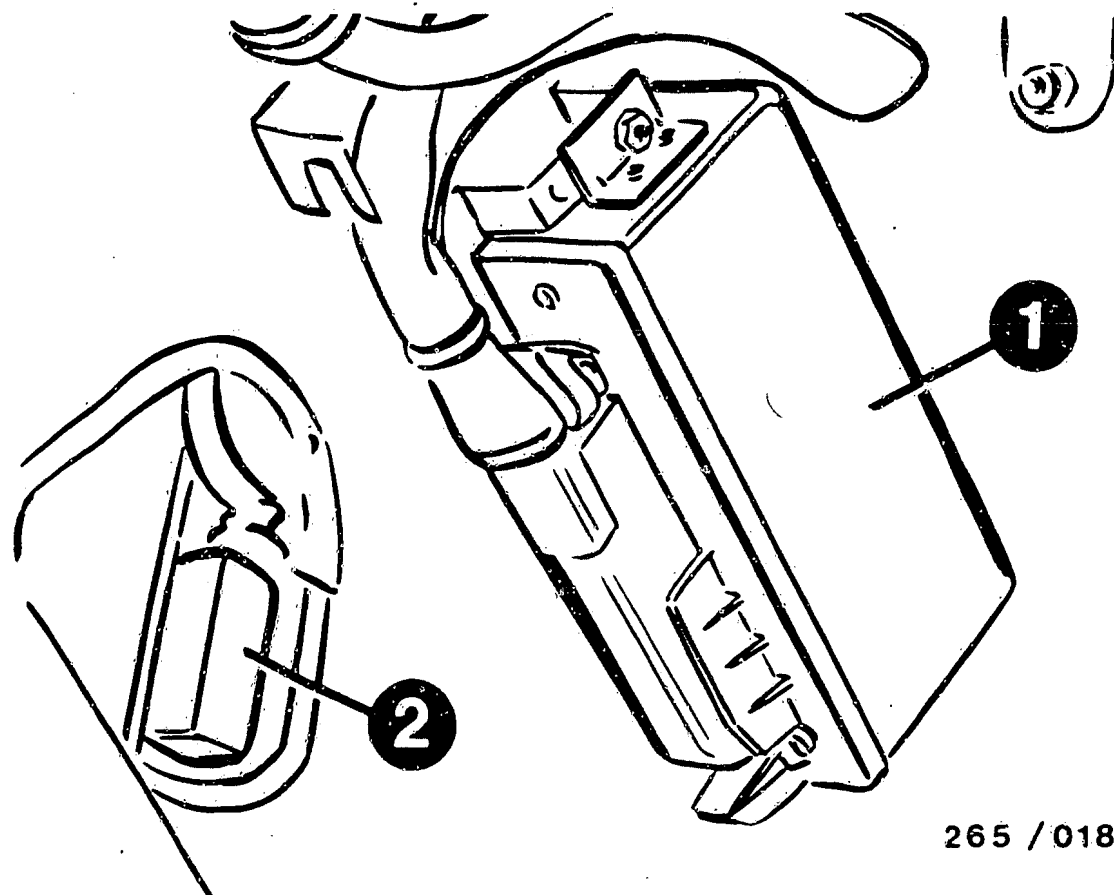


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INSTALLATION POSITION OF COMPONENTS

- 1 = Wheel-speed sensor, front
- 2 = Brake assembly
- 3 = ABS warning lamp

- 4 = Hydraulic modulator
- 5 = ABS controller
- 6 = Wheel-speed sensor, rear



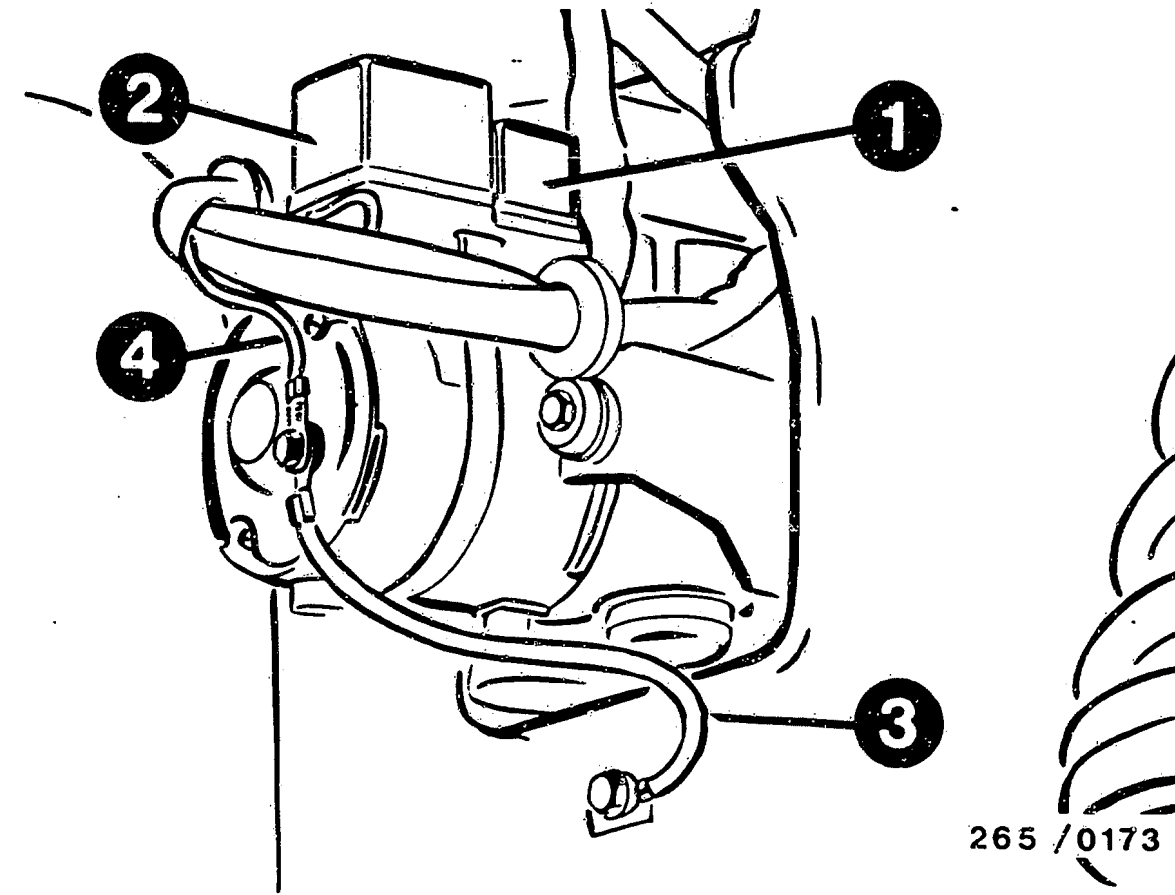
265 / 0189

- 1 = ABS controller
- 2 = Hood release mechanism

INSTALLATION POSITION OF COMPONENTS (continued)

The installation locations always refer to the direction of travel.

- * Controller:
In driver's footwell on the left above hood release mechanism.
- * Over-voltage protection relay:
In central-electrics console, relay no. 11
- * ABS warning lamp:
In instrument cluster. Symbol: ABS.
- * Stop-lamp switch:
At brake pedal lever.



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- 1 = Valve relay
- 2 = Motor relay
- 3 = Ground connection, return pump
- 4 = Ground connection, valve relay (if provided).

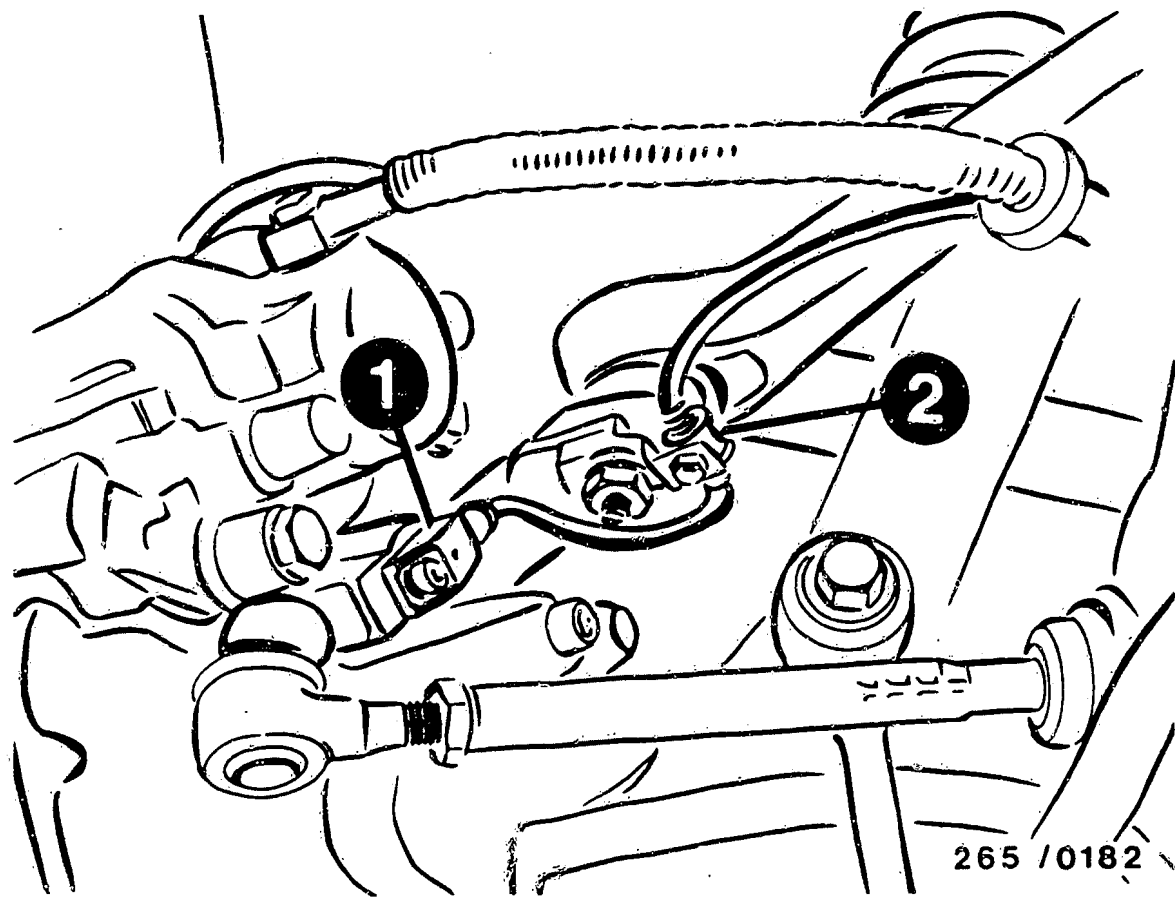
INSTALLATION POSITION OF COMPONENTS (continued)

- * Hydraulic modulator:
In engine compartment front left in penetration through wheel wall.
To remove, unscrew left-hand wheel and remove cover in wheel wall.

The hydraulic modulator is not to be repaired, but rather only replaced as a complete unit.
Exception: Relay change.

Pay attention to correct assignment of brake-line connections.

- * ABS ground terminal:
Beneath steering console, in vicinity of stop-lamp switch.



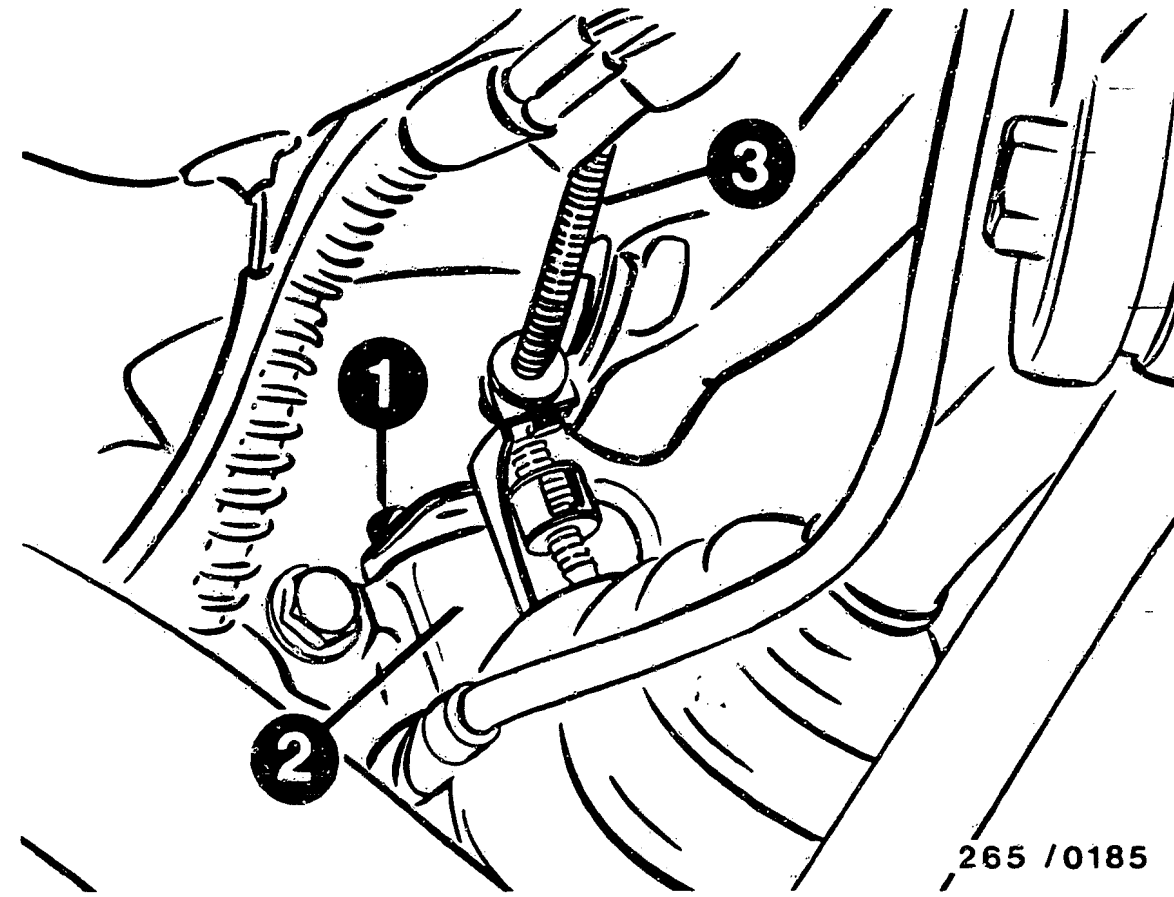
- 1 = Wheel-speed sensor
- 2 = Cable clamp

INSTALLATION POSITION OF COMPONENTS (continued)

- * Front-axle wheel-speed sensor:
One each on left and right in steering knuckles.

Wheel-speed-sensor plug connections:

In engine compartment on left and right at spring strut dome.



- 1 = Wheel-speed sensor, rear
- 2 = Wheel carrier
- 3 = Wheel-speed-sensor lead

INSTALLATION POSITION OF COMPONENTS (continued)

- * Rear-axle wheel-speed sensor:
One each on left and right in wheel carrier.

Wheel-speed-sensor plug connections:

On left and right at rear-axle cross-member.

SPECIAL FEATURES (CONTINUED)

Self-diagnosis with flashing-code output:

CAUTION: Do not detach control-unit plug and do not disconnect battery, as otherwise fault memory will be cleared.

Scope of diagnosis:

- * Self-diagnosis, readout of fault memory
- * Switching-input diagnosis
- * Actuator diagnosis

Test prerequisites:

Voltage supply, positive and negative, of control unit O.K.

Battery positive: connected to term. 4 and via
main relay, term. 87/1 to term. 9

Positive of term. 15: connected to term. 35

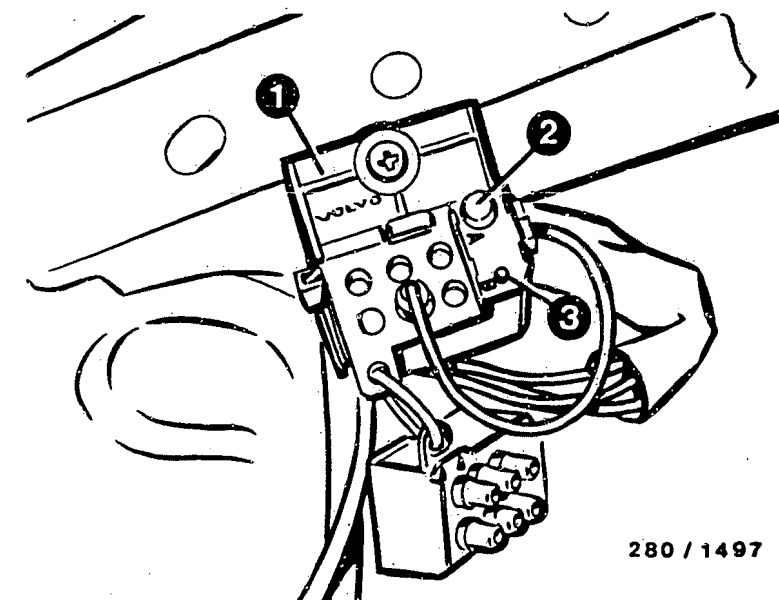
Ground: connected to term. 5 and term. 17

Self-diagnosis is effected by way of a flashing code. An indicator lamp (LED) is provided for this purpose in the diagnosis unit at the left-hand spring-strut dome.

Following elimination of fault, clear fault memory and repeat test as a check.

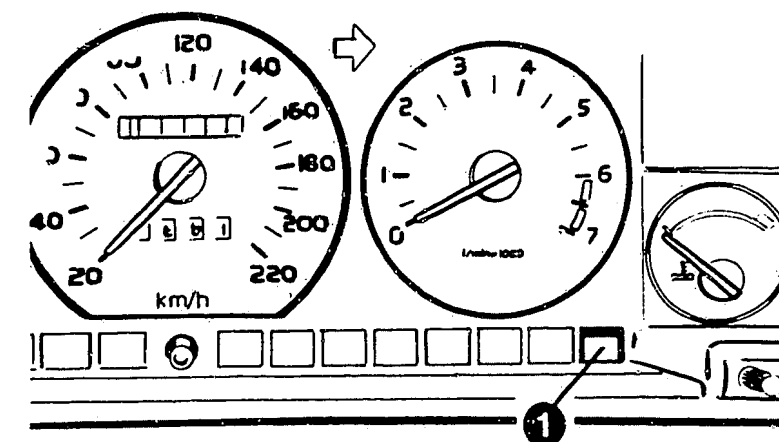
Note: Clearing is only possible when all faults have been output at least once. They cannot be cleared by switching off the ignition.

- * The presence of faults of relevance to exhaust emissions and safety (carb faults) are indicated by the check-engine lamp in the instrument panel.



- 1 = Diagnosis unit
- 2 = Button
- 3 = Indicator lamp (LED)

- 1 = Check-engine lamp



SPECIAL FEATURES (continued)

Activation of self-diagnosis:

If the fault memory has been cleared:

- * Test run for at least 5 minutes
- * Coolant temperature at least 80° C.
- * Engine speed must exceed 3000 min⁻¹ at least once.
- * Accelerator pedal must be completely depressed at least once.
- * If the engine doesn't run, start for at least 6 seconds and leave ignition "ON".

Self-diagnosis can be activated with the engine running (idling speed) as well as with the engine not running and the ignition on.

The flashing code "1 1 1" is output if no fault has been stored.

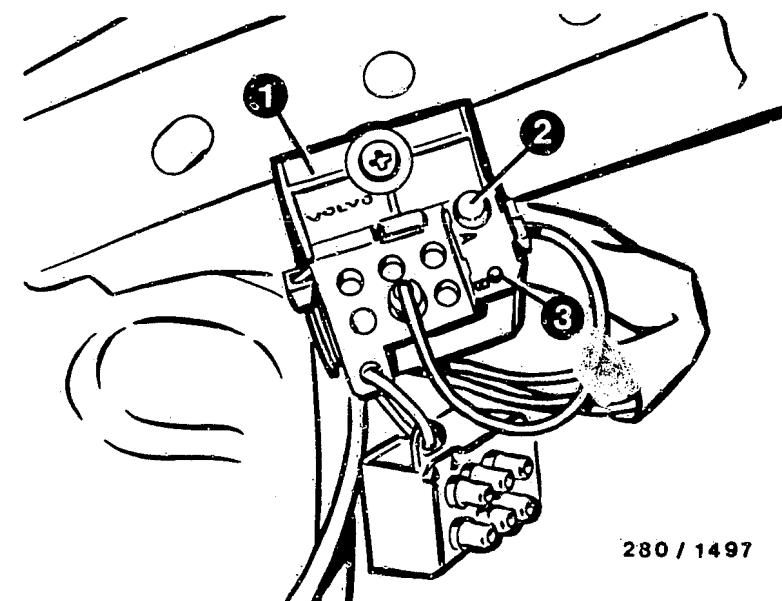
ACTIVATION OF SELF-DIAGNOSIS: Insert lead of diagnosis unit into socket 2. Press button for at least 2.5 s. Flashing code is displayed by way of the indicator lamp (LED).

ACTIVATION OF SWITCHING-INPUT DIAGNOSIS: Insert lead of diagnosis unit into socket 2. Press button twice for at least 2.5 s. Flashing code is displayed by way of indicator lamp (LED). A switch-actuation prompt causes the indicator lamp to flash. Following actuation, the respective switch code is displayed by way of the indicator lamp.

ACTIVATION OF ACTUATOR DIAGNOSIS: Insert lead of diagnosis unit into socket 2. Press button 3 times for at least 2.5 s. Indicator lamp (LED) flashes in line with actuation rhythm of component actuated. The components are actuated consecutively. The control unit switches off automatically following three repeats.

CLEARING FAULT MEMORY: Switch on ignition. Press button for at least 5 seconds. Wait until indicator lamp (LED) lights up. Press button again for at least 5 seconds.

Activate self-diagnosis again after memory has been cleared. The indicated fault code must be "1 1 1".



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- 1 = Diagnosis unit
- 2 = Button
- 3 = Indicator lamp (LED)

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

* Avoid injection of fuel when testing the compression.
To ensure this, disconnect pump relay.

For further precautionary measures, see brief instructions.

TROUBLE-SHOOTING CHART

Customer complaint (fault symptoms)

1. Starting motor operates, engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Idle problems (engine speed, exhaust gas).
4. Poor throttle take-up, flat spot during acceleration.
5. Engine missing (ignition, injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

Cause (component fault)										
*	*	*	*	*	*	*	*	*	*	Self-diagnosis
*	*	*	*	*	*	*	*	*	*	Switching-input diagnosis
*	*	*	*	*	*	*	*	*	*	Actuator diagnosis
*			*							Voltage at control unit
*	*	*	*		*					Intake system
*		*	*	*		*	*			Solenoid-operated injection valves
				*	*					Fuel delivery
*	*	*	*		*	*				Fuel pressure
	*	*	*			*				Tank ventilation system
*		*								Start control
			*							Overrun cutoff
		*	*		*	*				Throttle valve
		*	*	*	*	*		*		Lambda closed-loop control
						*				Catalytic converter
*		*	*	*						Interference
	*									Pump noise

SELF-DIAGNOSIS TEST TABLE

Fault indication Flashing code	Testing of component/function	Test instructions/ Test conditions	Term- inals	Set values
1 1 1	No fault detected		—	—
1 1 2	Control unit	This fault is indicated by the check-engine lamp lighting up continuously when driving. Replace control unit without performing further testing.	—	—
1 1 3	Solenoid-operated injection valves	Test injection-valve internal resistance: Test connecting leads between control unit and injection valves for short-circuit and open-circuit. Check leads of main relay via auxiliary relay	18	14.5...17.5 Ω
1 2 1	Hot-wire air-mass sensor	Switch on ignition Measure voltage at connector: Start engine Measure voltage at connector: Voltage is a function of load Test resistance at hot-wire air-mass sensor:	5 - 1 (+) (-) 3 - 2 (+) (-) 3 - 2	8...15 V 2...5 V 2,5...3,1 Ω
1 2 3	Temperature sensor (engine) and lead	Measure resistance directly at temperature sensor: +15...+30°C: approx. +80°C: Test leads from control unit to temperature sensor (NTC).	13 -NTC NTC- 1	1.45...3.3 k Ω 280...360 Ω Approx. 0 Ω Approx. 0 Ω
1 3 1	No engine-speed signal	Check lead from LH control unit, term. 1 to EIK control unit for continuity. Test ignition signal with motortester at control unit, term. 1.	1 - 17	Approx. 0 Ω

SELF-DIAGNOSIS TEST TABLE

Fault indication Flashing code	Testing of component/function	Test instructions/ Test conditions	Terminals	Set values
1 3 2	Supply voltage of control unit with engine running	Supply voltage too low: Check voltage drop at positive and ground terminal. Charge battery, check alternator system. Supply voltage too high: Check alternator system.	9 - 5 (+) (-)	8...15 V with engine running
1 3 3	Throttle-valve switch, idle and lead.	Incorrect idle-switch setting. Check resistance directly at throttle-valve switch. Throttle valve closed: Throttle valve open: Check lead from control unit to throttle-valve switch.	2 - 18 2 - 2	0 Ω Infinity Ω Approx. 0 Ω
2 1 2	Lambda sensor	Lead to lambda sensor, open-circuit, short-circuited to ground or battery voltage. Watch out for worn cable insulation! Check sensor heating. Sensor clogged.	24	
2 1 3	Throttle-valve switch, full load and lead	Check resistance directly at throttle-valve switch. Throttle valve closed: Throttle valve completely open: Check lead from control unit to throttle-valve switch.	3 - 18 3 - 3	Infinity Ω Approx. 0 Ω Approx. 0 Ω
2 2 1	Lambda closed-loop control outside working range (control limits exceeded or dropped below)	Lead to lambda sensor: open-circuit, short-circuited to ground or battery voltage Watch out for worn cable insulation! Check sensor heating. Sensor clogged Intake system leaking Tank ventilation valve permanently open Injection valves defective Hot-wire air-mass sensor defective	24	

SELF-DIAGNOSIS TEST TABLE

Fault indication Flashing code	Testing of component/function	Test instructions/ Test conditions	Term- inals	Set values
2 2 3	No idle-speed- regulation function	Check voltage supply at idle actuator: Check lead from control unit to idle actuator for continuity. Check resistance directly at idle actuator: Check signal at control unit.	2-grd. 32	8...15 V Approx. 0 Ω 4...12 Ω
2 3 1	Adaptation limits of lambda closed-loop control (multi) reached	Check intake system for leaks. Check lambda clsd.-lp. ctrl. for proper functioning. Check fuel pressure. Check tank ventilation system.		
2 3 2	Adaptation limits of lambda closed-loop control (additive) reached	Check inj. valves for proper functioning and leaks. Check hot-wire air-mass sns. for proper functioning. Fuel tank emptied.		
3 1 1	Speed signal	Check signal at control unit Check lead from speed sensor to control unit for continuity.	34 34	Approx. 0 Ω
3 1 2	Lambda open-loop ctrl. (knock enrichment)	Check lead from control unit to ignition control unit for continuity.	28 - 4	Approx. 0 Ω
3 2 2	Self-cleaning of hot wire	Check lead from control unit to hot-wire air-mass sensor for continuity.	8 - 4	Approx. 0 Ω

SWITCHING-INPUT-DIAGNOSIS TEST TABLE

Fault indication Flashing code	Testing of component/function	Test instructions/ Test conditions	Term- inals	Set values
- - -	Idle switch	LED flashes, actuate idle switch. LED flashes with respective flashing code following actuation of switch.	2	Flashing code 332
- - -	Full-load switch	LED flashes, actuate full-load switch. LED flashes with respective flashing code following actuation of switch.	3	Flashing code 333
- - -	No engine-speed signal	LED flashes, start engine. LED flashes with respective flashing code after starting.	1	Flashing code 331
- - -	A/C preparation switch	LED flashes, actuate A/C preparation switch. LED flashes with respective flashing code following actuation of switch.	15	Flashing code 114
- - -	A/C compressor switch	LED flashes, start engine. Actuate air-conditioning switch. LED flashes with respective flashing code following actuation of switch/switch-on of compressor.	14	Flashing code 134
- - -	Drive switch (automatic only)	LED flashes, actuate drive switch. LED flashes with respective flashing code following actuation of switch.	30	Flashing code 124

ACTUATOR-DIAGNOSIS TEST TABLE

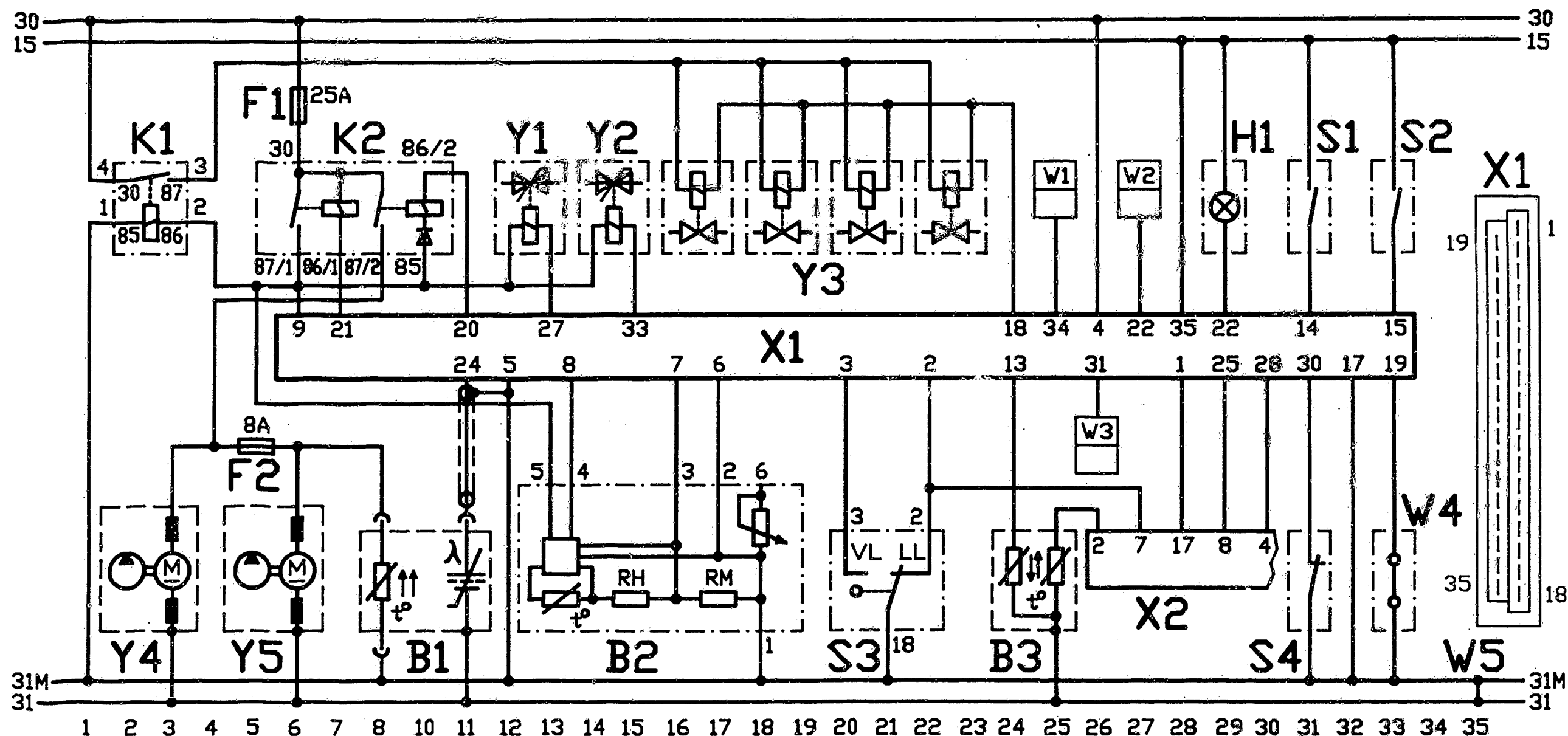
Fault indication Flashing code	Testing of component/function	Test instructions/ Test conditions	Terminals	Set values
	Solenoid-operated injection valves	<p>Detach plugs from all injection valves. Connect one injection valve in each case. It must be possible to hear connected injection valve working. Perform test consecutively on all injection valves.</p> <p>Test injection-valve int. resistance (+15...+30°C)</p> <p>Check connecting leads from control unit to injection valves for short-circuit and open-circuit.</p> <p>Check main-relay lead.</p>	18	<p>Indicator lamp (LED) flashes in line with component actuation rhythm</p> <p>14.5...17.5 Ω</p>
	Idle actuator	<p>It must be possible to hear/feel idle actuator working.</p> <p>Test idle-actuator internal resistance (+15...+30°C)</p> <p>Check leads from control unit/ignition and starting switch to idle actuator for short-circuit and open-circuit.</p>	33	<p>Indicator lamp (LED) flashes in line with component actuation rhythm</p> <p>4...12 Ω</p>
	Tank ventilation valve	<p>It must be possible to hear/feel tank ventilation valve working.</p> <p>Test internal resistance of tank ventilation valve.</p> <p>Check leads from control unit/ignition and starting switch to tank ventilation valve for short-circuit and open-circuit.</p>	27	<p>Indicator lamp (LED) flashes in line with component actuation rhythm</p> <p>35...55 Ω</p>

TEST SPECIFICATIONS

Component/function	Set values
Electric fuel pump	
* Delivery at return line:	min. 800 cm ³ /30 s
* Supply voltage under load:	min. 12 V
* Delivery of pre-supply pump:	min. 900 cm ³ /30 s
Pressure regulator	
* Fuel pressure with engine stopped: at idle:	2,8...3,2 bar Approx. 0.5 bar less
Fuel system, leakage	
* Fuel pressure after engine has been stopped for 20 min.:	min. 1.0 bar
Idle actuator	
* Resistance at +15...+30°C :	4...12 Ω
Hot-wire air-mass sensor	
* Resistance between term. 6 and term. 3:	0...1100 Ω
term. 3 and term. 2:	2.5...3.1 Ω
Temperature sensor (engine)	
Twin version	
* Internal resistance at ambient temperature +15...+30°C:	1.45...3.3 k Ω
with engine at operating temperature approx. + 80°C:	280...360 Ω
Tank ventilation valve	
* Internal resistance:	35...55 Ω

TEST SPECIFICATIONS (continued)

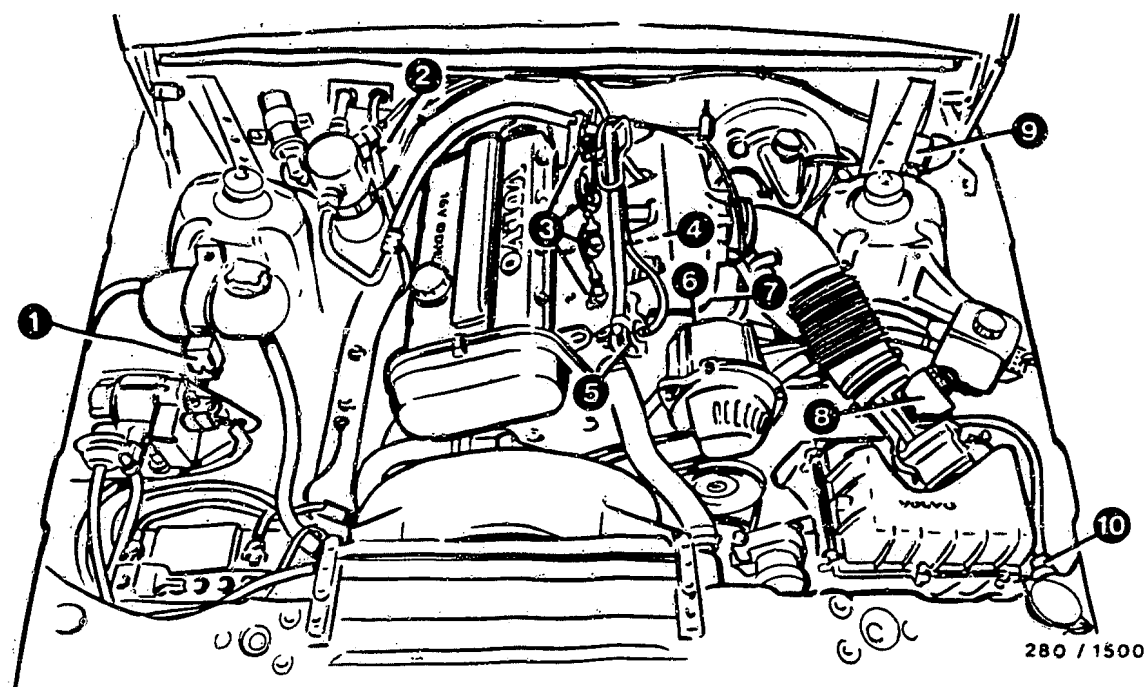
Component/function	Set values
Solenoid-operated injection valve	
* Internal resistance at ambient temperature +15...+30°C:	14.5...17.5 Ω
* Leakage after 60 s:	no droplets may drip off
Start control	
* Voltage at injection valve on start initiation:	greater than 1.5 V
after approx. 15 s:	approx. 0.5 V
NOTE! A 10 k Ω resistor is to be connected up in the lead to the control unit in place of the twin temperature sensor.	
Idle-speed adjustment	
Engine at operating temperature, approx. +80°C	
* Idle speed:	800...900 min ⁻¹
No need for adjustment since engine-speed regulation is adaptive.	
CO content	
Engine at operating temperature, approx. 80°C	
* (CO sampling ahead of catalytic conv.)	0,2...1,0 vol.% CO
No need for adjustment as lambda closed-loop control is adaptive.	
Lambda-sensor heating	
* Internal resistance (PTC) with engine not running:	1...15 Ω
Please refer to equipment and Autodata microcard for settings as regards ignition, valve clearance and other engine-related data.	



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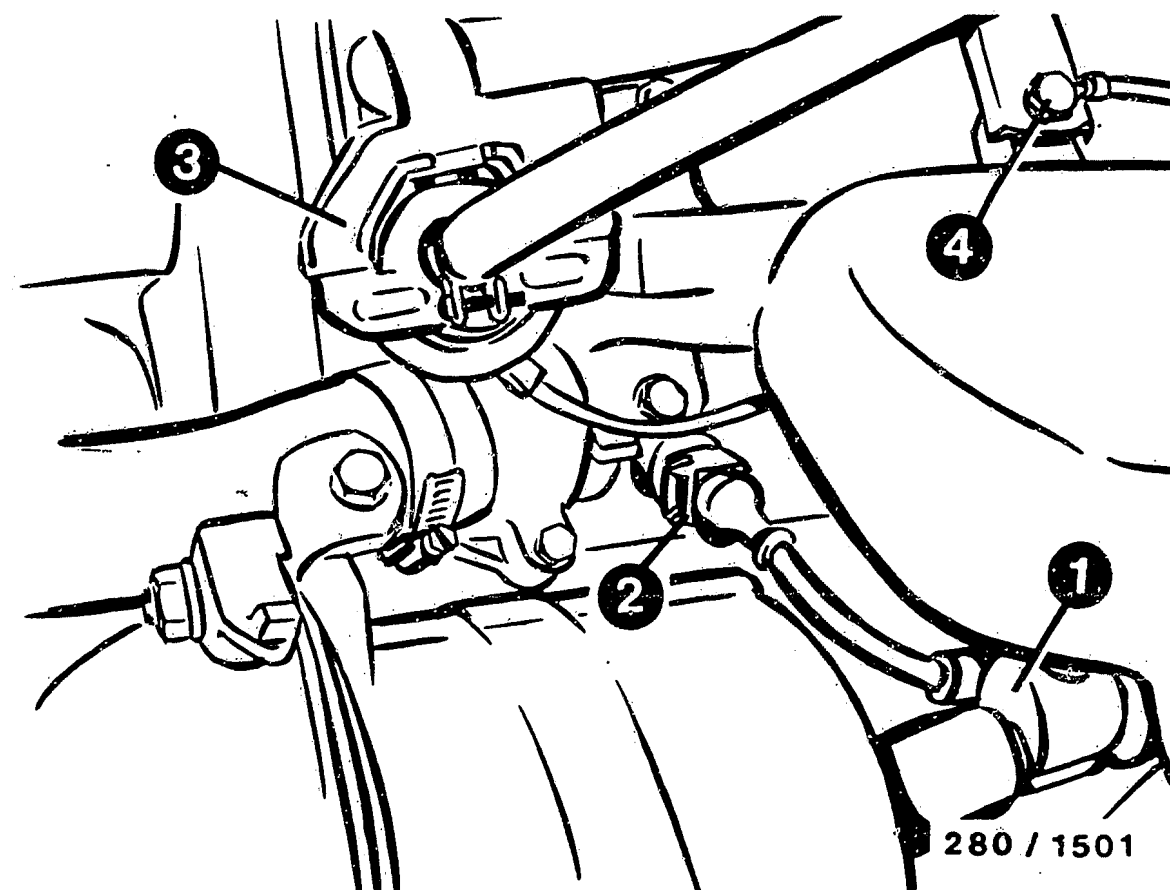
- | | | |
|--|----------------------------|---|
| B1 = Heated lambda sensor | K2 = Main/pump relay | W4 = Data encoding |
| B2 = Hot-wire air-mass meter | S1 = A/C switch | X1 = Control-unit plug - Jetronic |
| B3 = Twin temperature sensor (engine) | S2 = A/C readiness | X2 = Control-unit plug - ignition |
| F1 = Main/pump fuse | S3 = Throttle-valve switch | Y1 = Tank ventilation valve |
| F2 = Sensor-heater fuse | S4 = Drive switch | Y2 = Single-winding rotary actuator |
| H1 = Check-engine lamp | W1 = Speed sensor | Y3 = Solenoid-operated injection valves |
| K1 = Aux. relay (interference-suppress.) | W2 = Diagnosis prompt | Y4 = Electric fuel pump |
| | W3 = Consumption output | Y5 = In-tank pre-supply pump |

ELECTRICAL TERMINAL DIAGRAM



INSTALLATION POSITION OF COMPONENTS

- 1 = Auxiliary relay
- 2 = to plug connection of lambda sensor
- 3 = Solenoid-operated injection valves
- 4 = Ground terminal
- 5 = Pressure regulator
- 6 = to temperature sensor (engine)
- 7 = to idle actuator
- 8 = Hot-wire air-mass sensor
- 9 = Diagnosis unit
- 10 = Tank ventilation valve



- 1 = Idle actuator
- 2 = Temperature sensor (engine)
- 3 = Pressure regulator
- 4 = Ground terminal

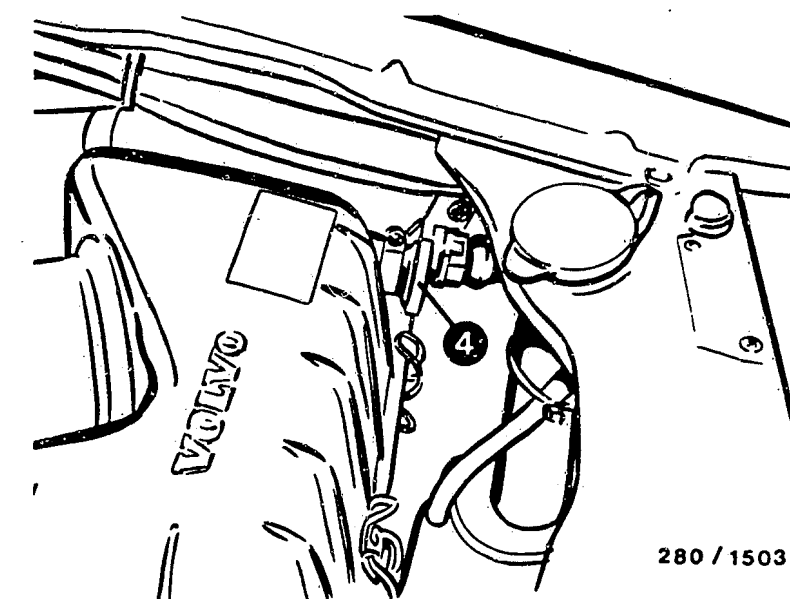
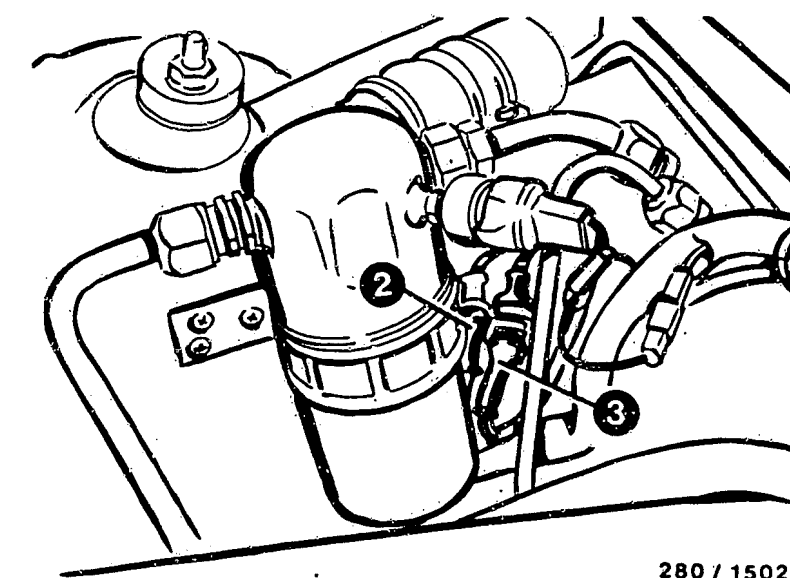
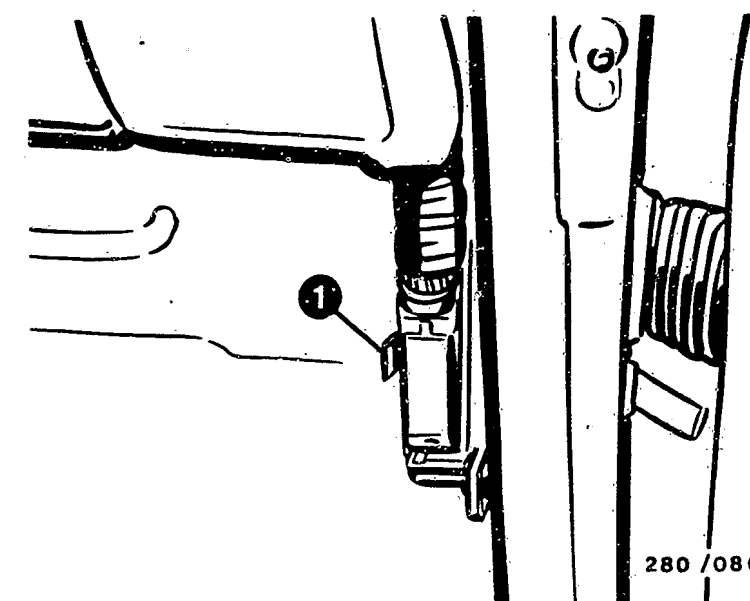
INSTALLATION POSITION OF COMPONENTS (continued)

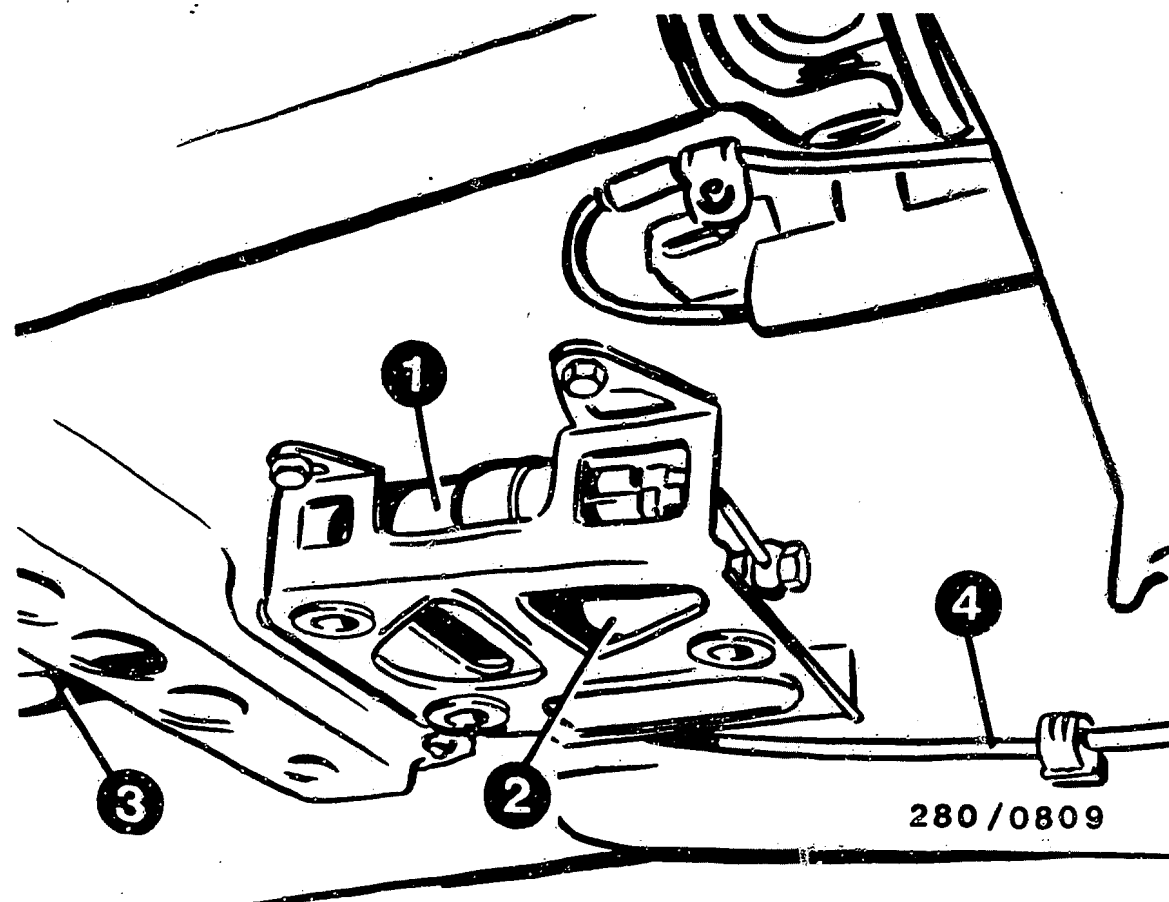
INSTALLATION POSITION OF COMPONENTS (continued)

- 1 = Control unit
- 2 = Lambda-sensor plug connection
- 3 = Lambda-sensor-heater plug connection
- 4 = Tank ventilation valve

The control unit is located behind a cover on the right-hand side in the front passenger's footwell.

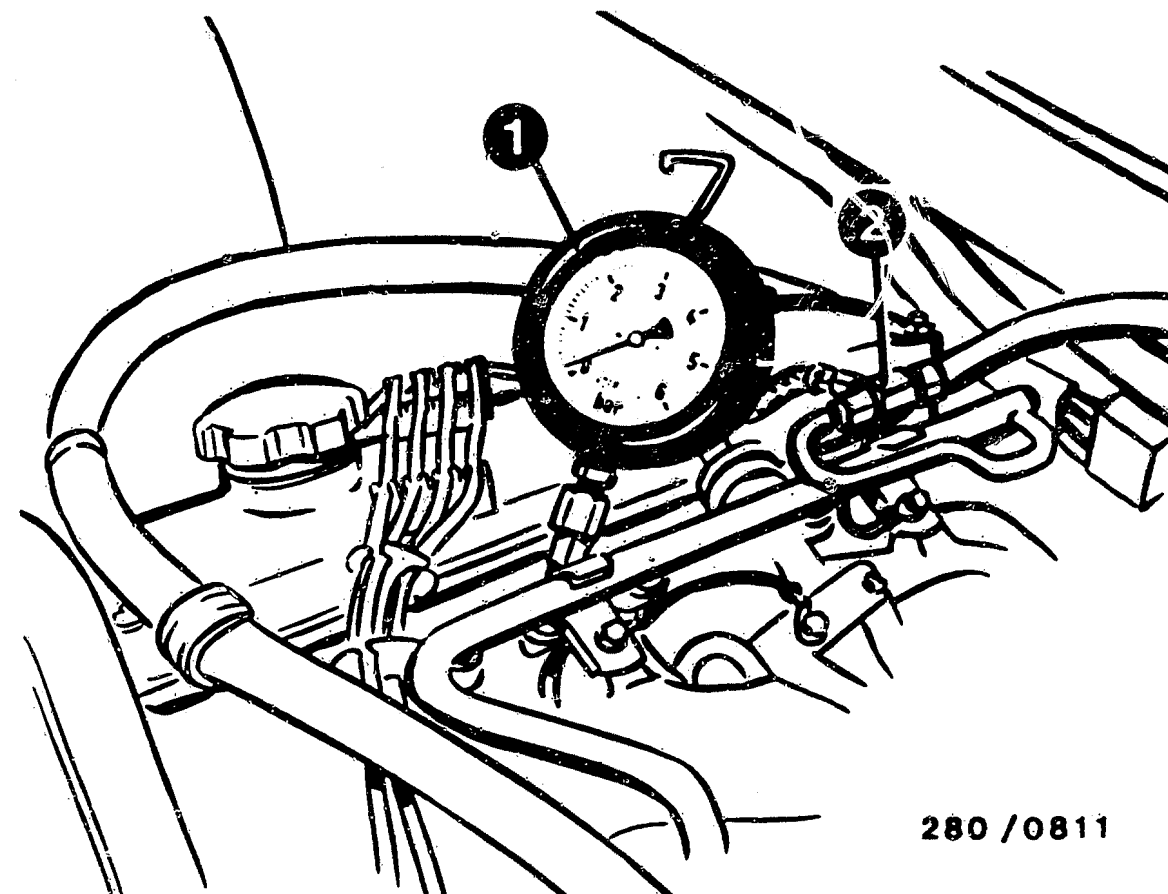
The pump fuse, main relay and pump relay are located in the passenger-compartment center console behind the ashtray.





- 1 = Electric fuel pump
- 2 = Fuel filter
- 3 = Fuel suction line
- 4 = Fuel delivery line

Pre-supply pump in tank (accessible via trunk).



- 1 = Pressure gauge
- 2 = Connection part KDJE-P 100/14

Fuel pressure test

CAUTION! When unscrewing hose, ensure that no fuel gets on to hot parts of engine.

Connect pressure gauge or pressure measuring device. Unscrew fuel delivery line at fuel distribution pipe.

Connect up connection part KDJE-P 100/14. Make sure connection is tight.

Trouble-shooting instructions : VOL-5006
BOSCH system : ABS
Make of vehicle : VOLVO
Basic microcard : PKW-040 G01

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Test requirements	05
Rapid diagnosis chart	07
Test specifications	19
Electrical terminal diagram	21
Installation position of components, notes on removal and installation	23

SPECIAL FEATURES

This microcard, valid at the time of publication, contains trouble-shooting instructions for the following models:

Volvo 740, 760, 780
09.1987->

- * ABS with 3 wheel-speed sensors and 3 hydraulic channels.
- * New features as of 9.87:
 - **Hydraulic modulator in engine compartment.
 - **Controller in passenger compartment
 - **Wheel-speed-sensor for rear axle:
Installation without shims.
 - **Sensor ring gears with 96 teeth.
- * New features as of 9.88:
 - **Wheel-speed sensor with direct plug connection for rear axle, installation without shims.
 - **Sensor ring gears with 48 teeth.
 - **New controller.
 - **No signal converter for speedometer.
- * New hydraulic modulator 0 265 200 054 as of mid 89:

Hydraulic connections for rear axle (h) and front, left (l) converted to M12 x 1, so as to avoid mix-ups.

STRUCTURE, USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

For a detailed description of trouble-shooting, see the basic instructions.

ATTENTION :

The set values, terminal assignments and special features of these vehicle-specific brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

- * For safety reasons, the hydraulic modulator must not be repaired, but be exchanged as a complete unit.
Exception: relays.
- * Do not loosen any screws on the hydraulic modulator!
Danger of fatal accident due to brake failure.
- * Caution when handling brake fluid.
Poisonous!

For further information, see basic instructions.

For production reasons:
continued on the following
coordinate.

TEST REQUIREMENTS FOR TESTING WITH ABS2 LED TESTER

- * Regulatory tire size fitted?
- * Check for firm seating of ground of return-supply pump.
- * Check for firm seating and corrosion of ground of overvoltage-protection relay term. 31.
- * Check for firm seating of ground strap between engine block and vehicle frame.
- * Check for leaks in hydraulic connections at hydraulic modulator and sealing points (visual examination).
- * If the ABS warning lamp lights up intermittently when driving (e.g. after switching on loads) and goes out again by itself, check the battery and power supply (alternator, regulator and voltage drops).
- * If the ABS warning lamp lights up constantly and does not go out, check the following points:
 - Controller plug sitting correctly on controller and latched?
 - All plug contacts O.K.?
 - Spring contacts latched?
 - Check installation position for correct seating of seal ring in controller plug, rounded side downward.

- Check wheel-speed-sensor leads for correct assignment at controller plug:

Wheel-speed sensors:

front left to term. 6 and term. 4.
front right to term. 23 and term. 21.
rear left to term. — and term. —.
rear right to term. — and term. —.
rear axle to term. 7 and term. 9.

- V-belt snapped?
(Alternator provides no voltage, charge-indicator lamp and ABS warning lamp light up).
- * Connect ABS 2 LED tester to ABS wiring harness.
- Disconnect and connect controller only with ignition switched off.
- For testing, switch on ignition in all program-selector-switch positions (tester operates with current supply from vehicle battery).
- Observe LED (green) for current supply in all program-selector-switch positions.

C A U T I O N !

Do not drive with tester connected!
The brake system must be bled of air before the ABS test. Do not activate the ABS tester while the system is being bled.
Repeat the complete test program after any repairs are carried out.
The Antiskid System is a vehicle safety system.
Work on the system demands detailed knowledge of the system.
The conventional brake system must be O.K.

General information for trouble-shooting:

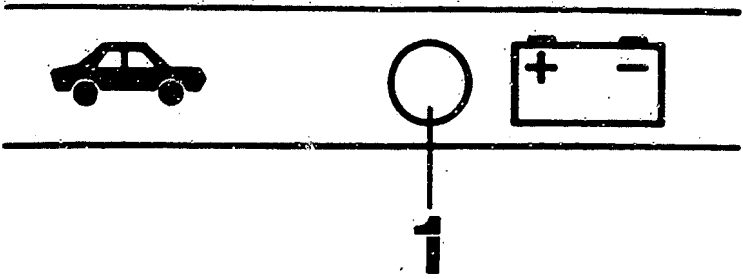
Check all leads for short circuit to ground and contact with positive leads and watch out for worn cable insulation and pinched leads.

RAPID DIAGNOSIS CHART

Never drive with tester connected! Have all test prerequisites been met?

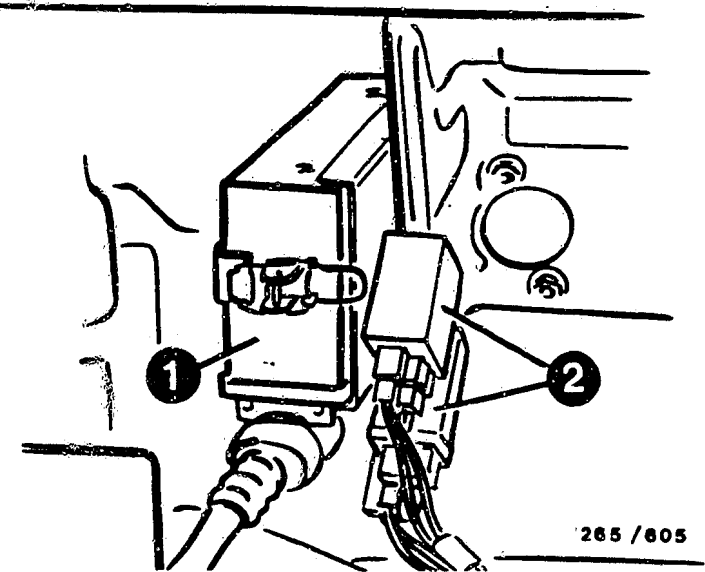
Program-selector-switch settings 1 - 6

Testing of (measurement at terminals)	Additional operation	Test speci- fication (indication)	Possible causes of trouble
Voltage supply (Term.1 and term.20)	Ignition on	LED 1 (top picture) lights up constantly	<ul style="list-style-type: none">* Fuse defective.* Inadequate battery charge.* Excessive voltage dips.* Check leads from relay plug to controller term. 1, to driving switch term. 15, to battery B+ and to ground terminal. Check ground lead to controller term. 20.* Over-voltage protection relay defective.



265 / 242

1 = ABS controller
2 = Over-voltage protection relay and signal converter

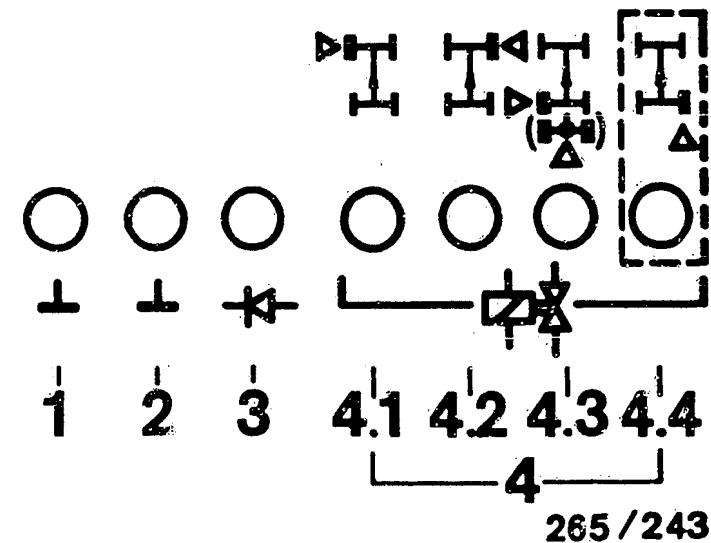


265 / 605

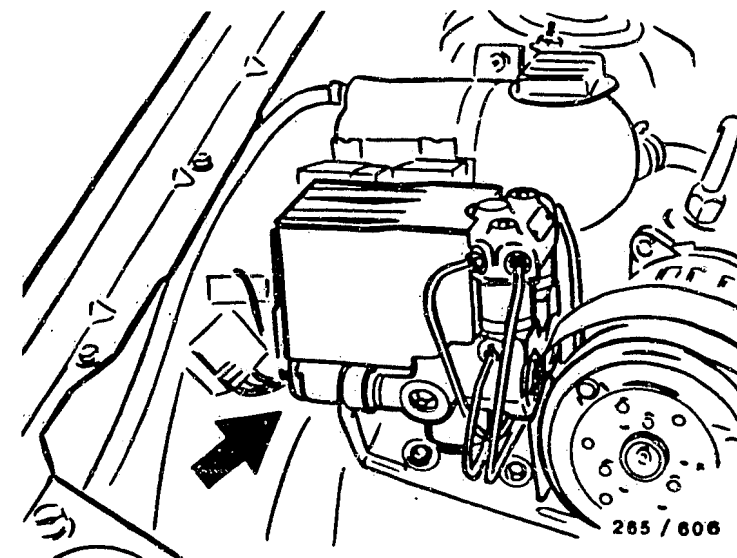
RAPID DIAGNOSIS CHART (CONTINUED)

Program-switch position 1 (3-channel hydraulic modulator)

Testing of (measurement at terminals)	Addition- al operation	Test specifi- cation (reading)	Possible causes of faults
Ground connection (term.10, term.34) Diode for warning lamp (term.29, term.32) Solenoid-operated valve internal res. (term.2, term.18, term.35, term.-) Off-position and ground connection of relay ABS warning lamp	Ignition on	6 LED (1 to 4.3) simultaneously brightly lit (top picture) ABS warning lamp in vehicle must light up	<ul style="list-style-type: none">* LED 1 and/or 2 (top picture) not lit: Check ground terminals for open circuit.* LED 3 (top picture) not lit: Diode defective, check ground connection of valve relay.* One or more LEDs 4 not lit: Check corresponding plug-in connection for solenoid-operated valve and leads. Solenoid-operated valve internal resistance 0,7...1,7 Ω* All LEDs 4 and LEDs 3 not lit: Check ground connection of valve relay, valve relay defective.* Dimmer lighting-up of an LED means contact resistance in the corresponding circuit.* ABS warning lamp not lit: Warning lamp defective. Note: all other 5 LEDs lit.



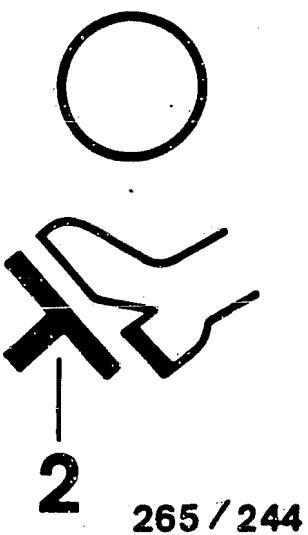
Arrow = Hydraulic modulator



RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 2

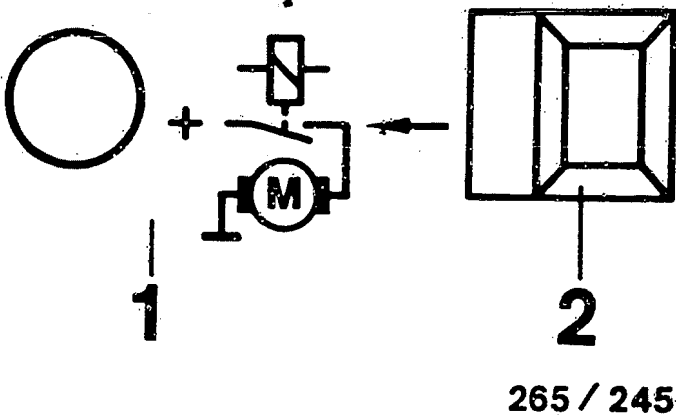
Under test (Measurement at the terminals)	Addition- al operation	Test specifi- cation (reading)	Possible causes of trouble
Alternator voltage from term. 61/D+ (term. 15)	Ignition on	LED 1 (top picture) lit.	* In some cases, LED does not go out until after burst of throttle (test is O.K. in this case).
	Start engine	LED 1 (top picture) goes out when engine running	* Test lead and signal from alternator term. 61/D+ * Alternator defective.
Stop-lamp switch (term. 25)	Ignition on	LED 2 (top picture) lit	* Stop-lamp switch defective. * Check lead to stop-lamp switch.
	Press brake pedal	LED 2 (top picture) goes out	* Lead incorrectly connected to to stop-lamp switch.



RAPID DIAGNOSIS CHART (CONTINUED)

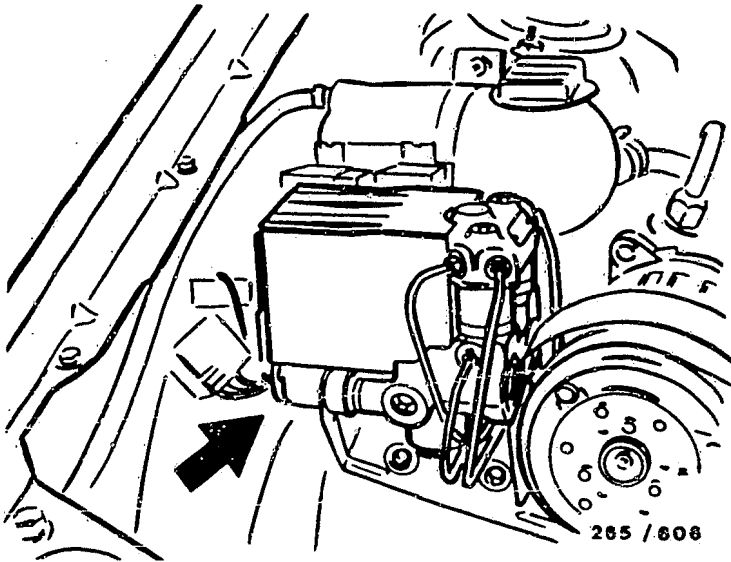
Program-selector-switch position 3

Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
Motor relay, pump motor in hydraulic modulator (term.14 and term.28)	Ignition on, press button 2 contin- uously (top picture)	LED 1 lights up, pump motor runs. After releasing button, LED con- tinues to light due to run-on of motor (top picture).	<ul style="list-style-type: none">* Motor relay defective* Test ground connection and positive terminal of pump motor* Test following leads: From controller term. 14 and term. 28 to hydraulic modulator term. 9 or term. 11. Positive leads to hydraulic modulator term. 10 and term. 12.* Pump motor or hydraulic modulator defective.



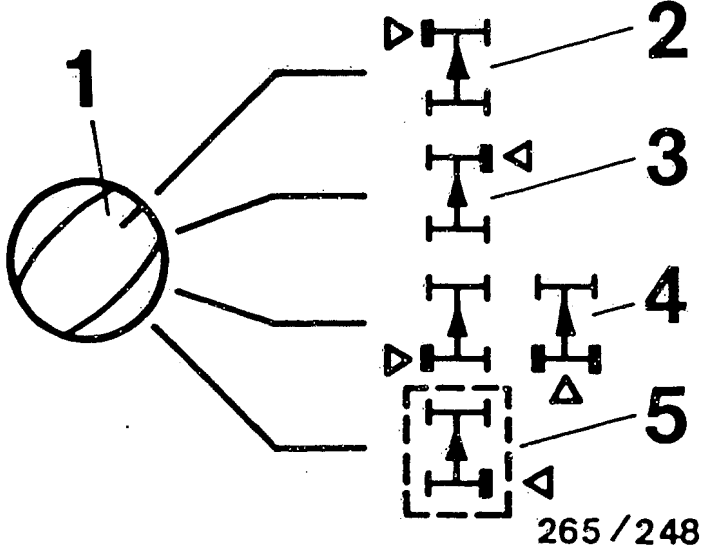
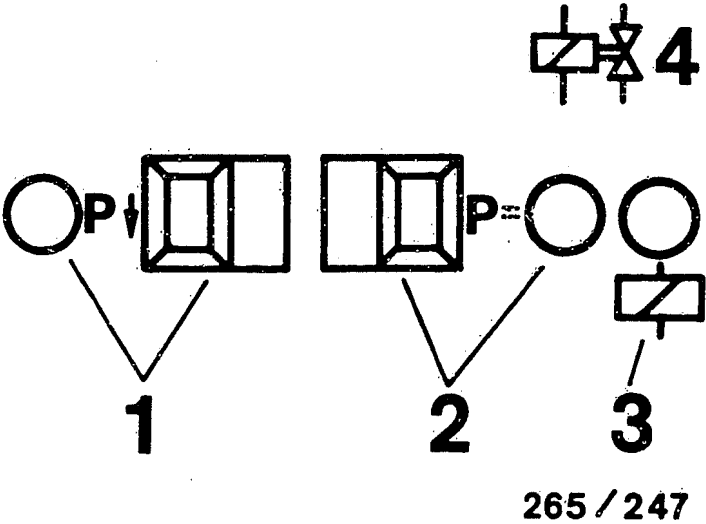
Program-selector-switch position 4 does not apply.

Arrow = Hydraulic modulator



RAPID DIAGNOSIS CHART (CONTINUED)
Program-selector-switch position 5 (3-channel hydraulic modulator)

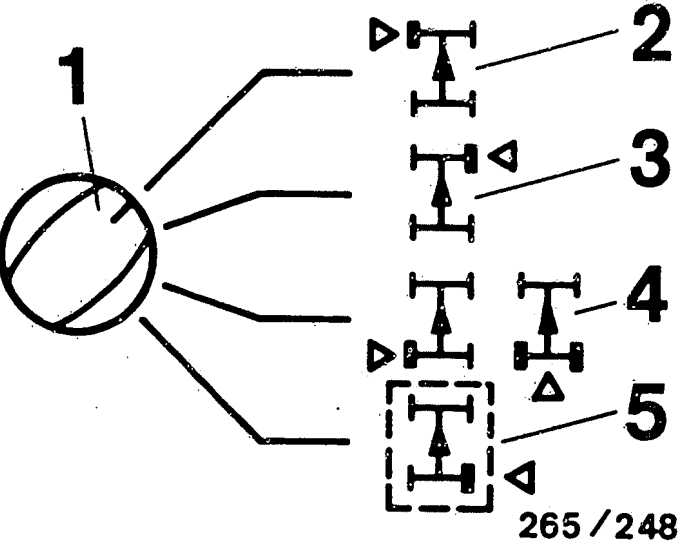
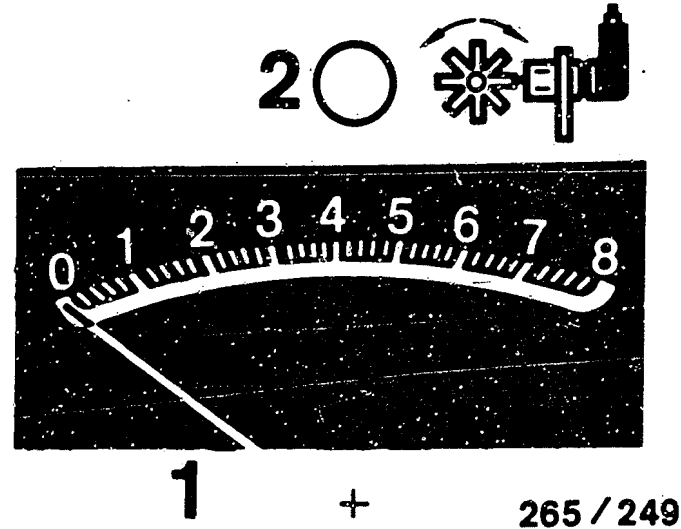
Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
Valve relay operation (term. 27)	Ignition on	LED 3 (upper illustration) lights up	* Valve relay (winding) or leads defective
Solenoid-operated valves in hydraulic modulator for operation and and mix-up. NOTE: Check each wheel separately in turn. Keep to operating sequence.	Chock up vehicle. Ignition on. The wheel being tested must be freely turnable by hand. Set switch 1 for wheel selection to wheel to be tested (center illustration).		* Repeat test with engine running * Valve relay (make contact) defective * Break in lead from valve relay term. 87 to B+ * Brake leads at hydraulic modulator mixed up
Operation, pressure holding	1. Constantly press push-but. P = (upper illustration)	LED P= (upper illustration) lights up	* Current value not obtained (LED P arrow or P= goes out; upper illustration); battery insufficiently charged. Repeat check with engine running.
	2. Constantly press brake pedal	Wheel turnable by hand	
	3. Release push-button P = (upper illustration)	LED P= goes out (upper illustration) Wheel locks	
Operation, pressure reduction	4. Press push-button P arrow (upper illustration)	LED P arrow (upper illustration) lights up, wheel turnable by hand	* Solenoid-operated valves correctly connected electrically? Wheel, front left: term. 2 Wheel, front right: term. 35 Wheel, rear left: term. - Wheel, rear right: term. - Rear axle: term. 18 * Hydraulic modulator defective
	5. Release push-button P arrow (upper illustration)	LED P arrow (upper illustration) goes out, wheel locks	
	6. Release brake pedal		



RAPID DIAGNOSIS CHART (CONTINUED)
Program-selector-switch setting 6 (3 wheel-speed sensors)

Testing of (measurement at terminals)	Additional operation	Test specifi- cation (indication)	Possible causes of trouble (see coordinates)
<p>Wheel-speed sensor for proper func- tioning and mix-up</p> <p>NOTE: Perform test con- secutively for each individual wheel.</p> <p>Wheel, front left: term.4 and term.6</p> <p>Wheel, front right: term 21 and term 23 Rear axle: term.7 and term.9</p>	<p>Jack up vehicle. Ignition on.</p> <p>It must be possible to turn the wheel to be tested freely by hand.</p> <p>When testing driven axle, the wheel not tested must be held.</p> <p>Set switch for wheel selection to wheel to be tested (bottom picture)</p> <p>Turn wheel by hand until LED 2 above instrument lights up without flickering.</p> <p>(Speed approx. 1 revolution per second). Then read off indication on instrument: (top picture)</p>	<p>1.Smallest reading greater than 1,6 scale divisions Test specifi- cation is not obtained: If applicable, detach control units for ETC and signal conversion and repeat test.</p> <p>2.Permissible fluctuation band max. 25 % from highest value indicated.</p>	<ul style="list-style-type: none">* Wheel-speed-sensor lead mixed up* Open-circuit in wheel- speed-sensor lead* Wheel-speed sensor defective Winding resistance Front axle: 0,6...1,6 k Ω Rear axle: 0,6...1,6 k Ω* Air gap between wheel- speed sensor and ring gear too large* Ring gear defective (e.g. corroded, dirty) or loose.* Ring gear with wrong number of teeth fitted Front axle: 96 or 48 teeth Rear axle: 96 or 48 teeth* Wheel-bearing play excessive* Indication given, LED2 does not light up: loose contact in wheel- speed-sensor lead.

A test drive is to be performed as a final step. The warning lamp must go out when the engine is running. Drive at at least 30 km/h. The warning lamp must not light up again when doing so.



TEST SPECIFICATIONS

Wheel-speed sensor

* Winding resistance at ambient temperature (-10°C...+120°C) for front wheels:	600...1600 Ω
rear axle:	600...1600 Ω

Hydraulic-modulator solenoid valves

* Winding resistance at ambient temperature (-10°C...+120°C):	0,7...1,7 Ω
---	-------------

Air gap (not adjustable) between wheel-speed sensor and ring gear

* at front wheels:	0,8 ± 0,5 mm
* at rear axle:	0,8 ± 0,5 mm

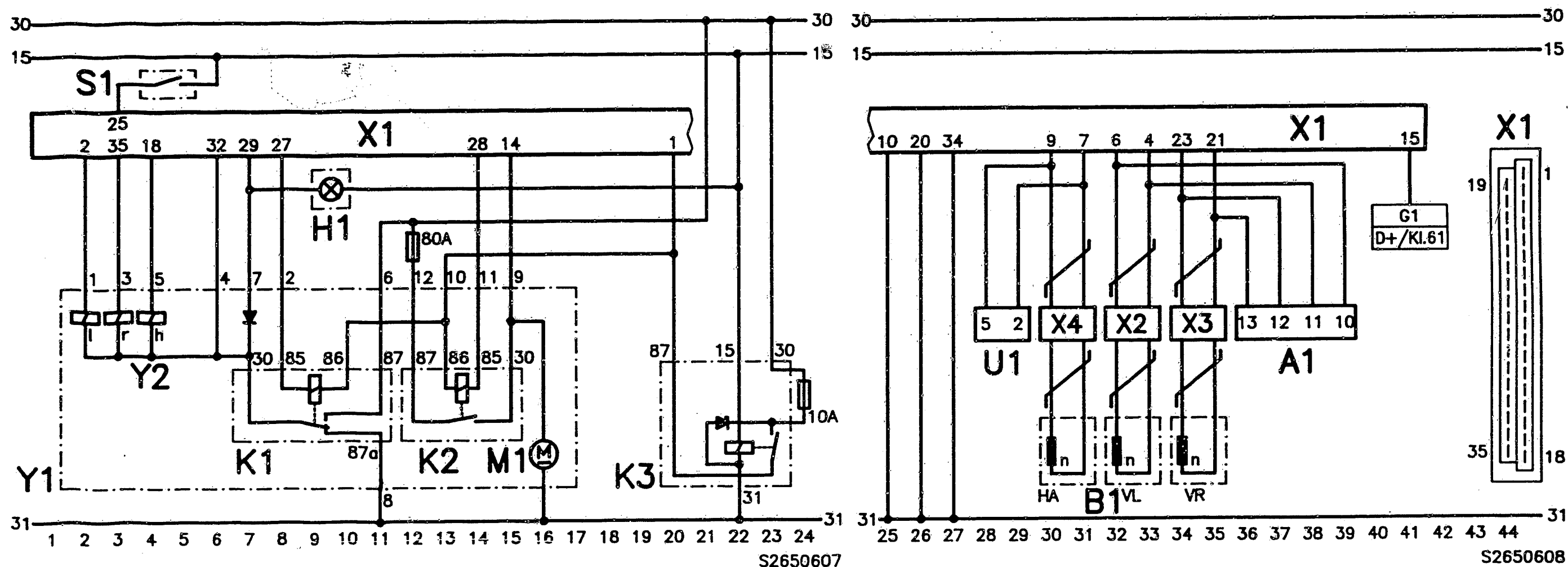
Tightening torque for

* Fastening screws of wheel-speed sensors:	> 8 Nm
* Brake-line connections at hydraulic modulator:	12...16 Nm

For production reasons:
continued on the following
coordinate.

Number of teeth of wheel-speed-sensor ring gears

* at front wheels up to 8.88:	96 teeth
up to 9.88:	48 teeth
* at rear axle up to 8.88:	96 teeth
up to 9.88:	48 teeth

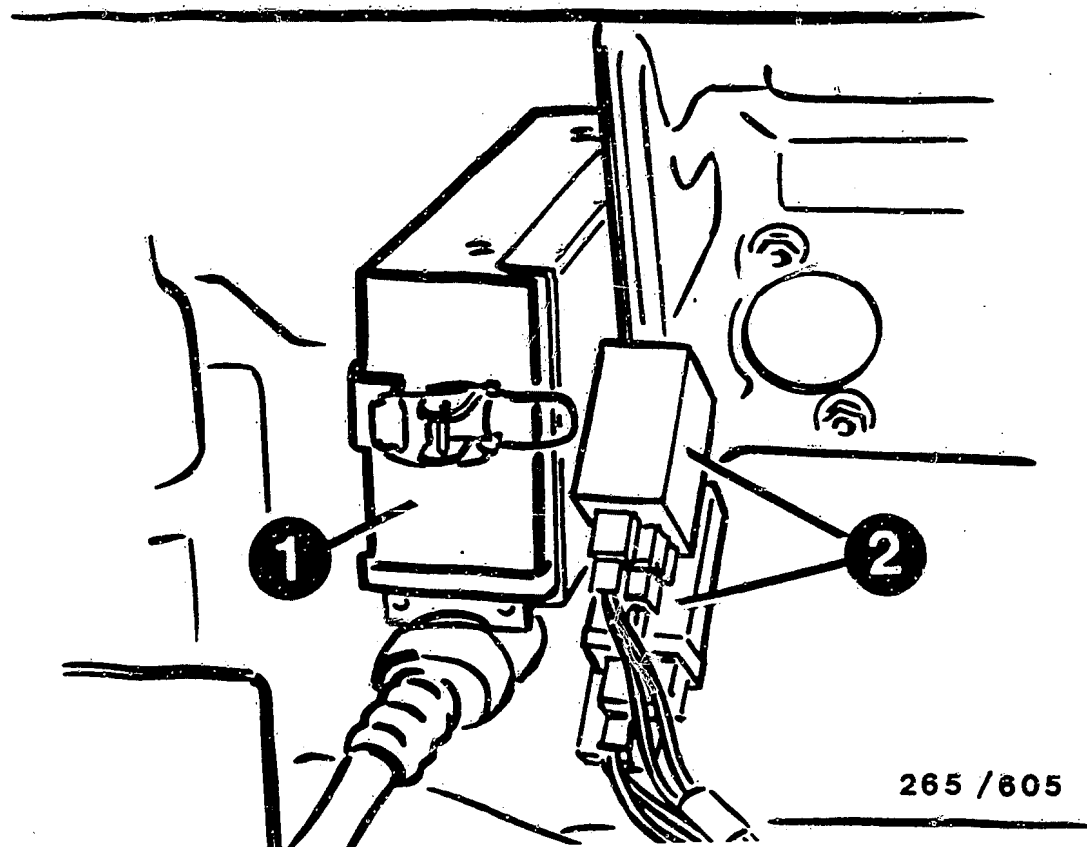


ELECTRICAL TERMINAL DIAGRAM

A1 = ETC control unit
(electronic traction control),
if applicable
B1 = Wheel-speed sensor
G1 = to alternator
H1 = ABS warning lamp
K1 = Valve relay
K2 = Motor relay
K3 = Over-voltage protec-
tion relay

M1 = Return-pump motor
S1 = Stop-lamp switch
U1 = Signal converter for speedometer;
not as of model year 89,
replaced by direct
connection to speedometer
X1 = Controller plug (35-pole)
X2...X4 = Wheel-speed-sensor plugs
Y1 = Hydraulic modulator
Y2 = Solenoid valves

HA = h = Rear axle
VL = l = Front left
VR = r = Front right

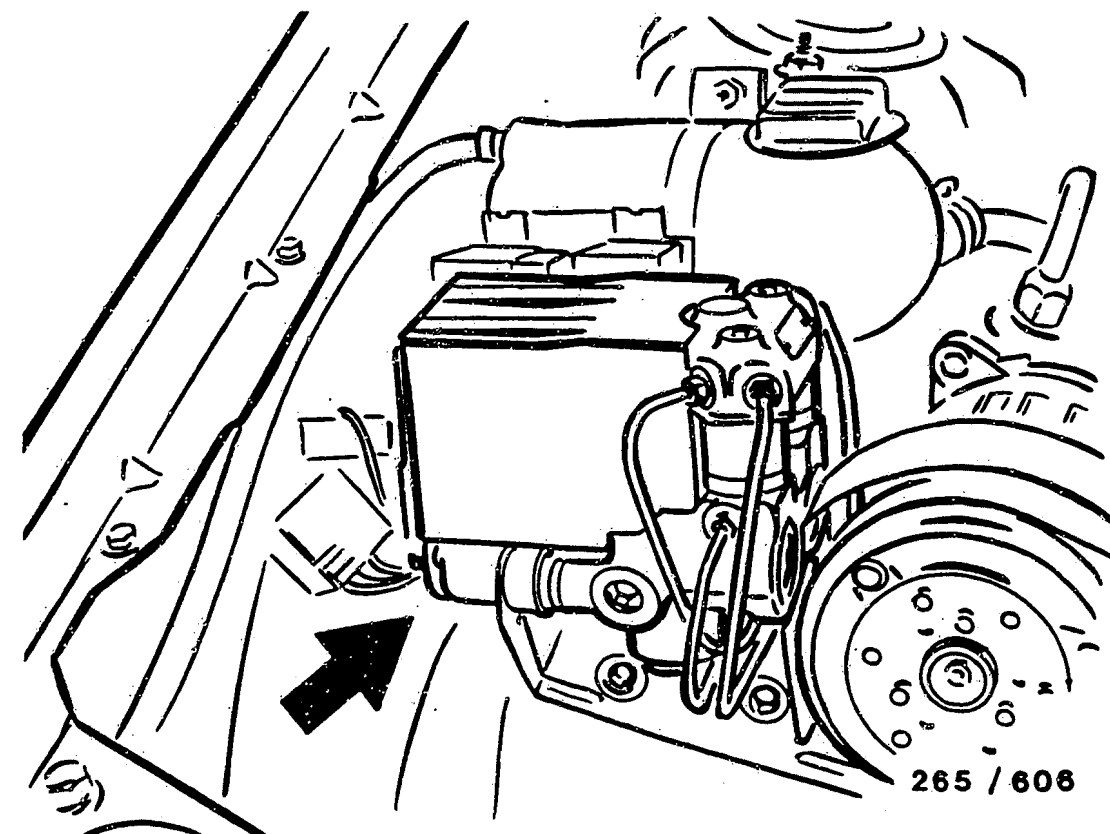


- 1 = ABS-controller
2 = Over-voltage protection relay
and signal converter

INSTALLATION POSITION OF COMPONENTS

The installation locations always refer to the direction of travel.

- * Controller:
On LHD vehicles on left beneath instrument panel next to pedal support; on RHD vehicles in right-hand footwell beneath instrument panel.
- * Over-voltage protection relay:
Beneath instrument panel at controller
- * ABS warning lamp:
in instrument panel.



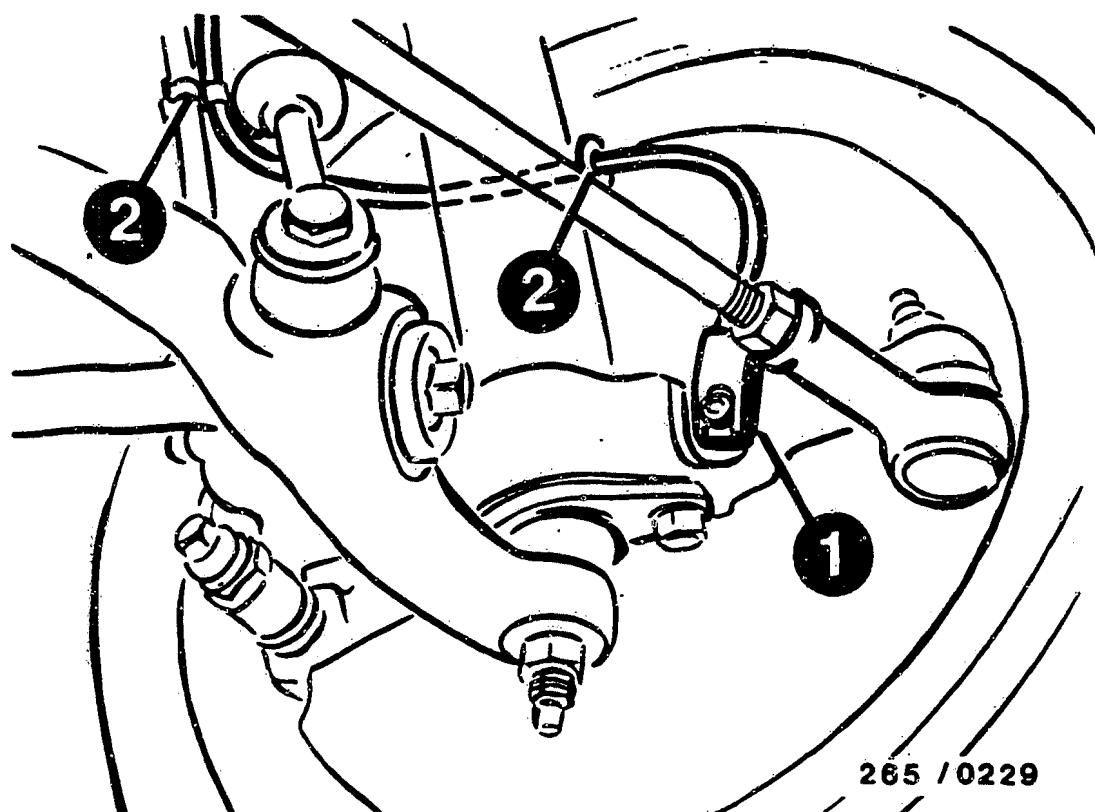
Arrow = Hydraulic modulator

INSTALLATION POSITION OF COMPONENTS (continued)

- * Hydraulic modulator:
In engine compartment on left-hand or right-hand wheel arch depending on engine version.

The hydraulic modulator is not to be repaired, but rather only replaced as a complete assembly.
Exception: Relay change.

Pay attention to proper assignment of brake-line connections.
- * Stop-lamp switch:
Beneath brake-pedal lever.
- * ABS ground terminal:
At right-hand or left-hand door hinge pillar.



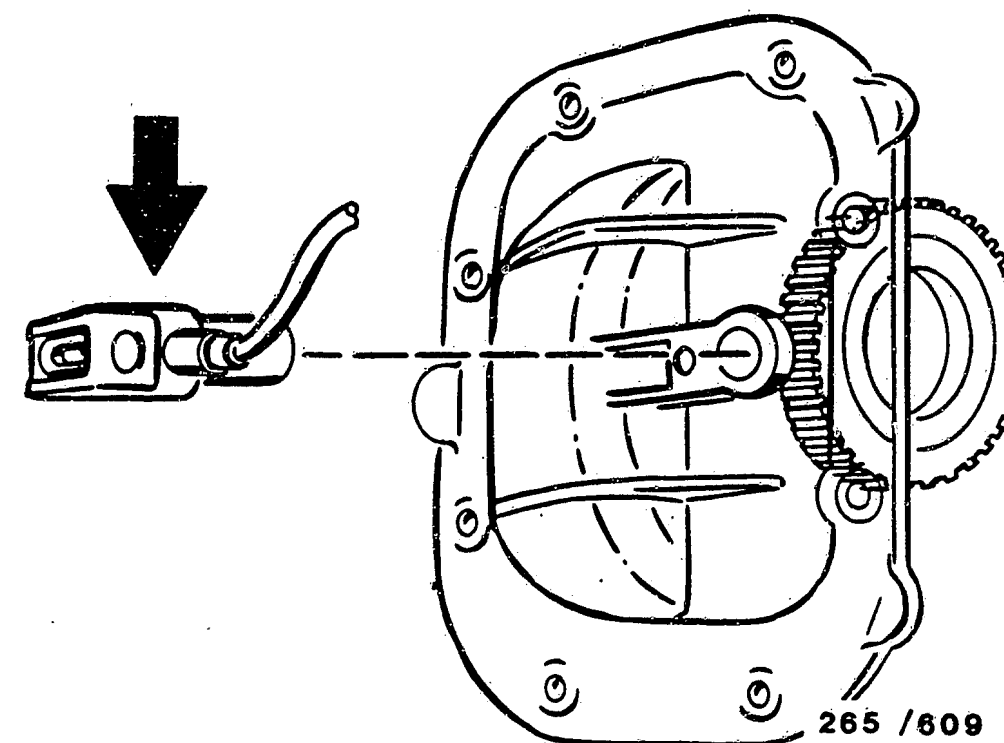
1 = Wheel-speed sensor, front

INSTALLATION POSITION OF COMPONENTS (continued)

- * Wheel-speed sensor, front axle:
One each on left and right in steering knuckles.

As of 9.88 change in number of teeth to 48 (previously 96).

Wheel-speed-sensor plug connections:
In engine compartment on left and right at spring-strut domes.



Arrow = Wheel-speed sensor, rear

INSTALLATION POSITION OF COMPONENTS (continued)

- * Wheel-speed sensor, rear axle:
Only one in final-drive housing.
Note: Do not mix up with wheel-speed sensor for ETC (electronic traction control)!

Sensor fitted without shims.
No need to adjust air gap.
As of 9.88 new sensor with direct plug connection and conversion of number of teeth to 48 (previously 96).

Wheel-speed-sensor plug connections:
In trunk.

Trouble-shooting instructions : AUD-5016
BOSCH system : TZ-H
Make of vehicle : AUDI
Basic microcard : PKW-129

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SPECIAL FEATURES

These brief instructions, valid at the time of publication, apply to the following Audi models:

AUDI Coupe	4/5-cyl. engine	8.81 ->
AUDI 80	4/5-cyl. engine	8.78 ->
AUDI 90	5-cyl. engine	10.84 ->
AUDI 100	4/5-cyl. engine	8.80 ->
AUDI 200	5-cyl. engine	8.83 ->
AUDI 4000	5-cyl. engine	8.80 ->
AUDI 5000	5-cyl. engine	8.80 ->

with
trigger box 0 227 100 103, ...137, ...142
(with current limitation) or trigger box
manufactured by Fairchild.

Ignition coil 0 221 122 023, ...349, ...379.

STRUCTURE AND USAGE

Tnese brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

TROUBLE-SHOOTING CHART

Customer complaint (fault symptoms)

- Starting motor operates, engine fails to start or starts only with difficulty.
- Engine starts but then dies.
- Idle problems (engine speed, exhaust gas).
- Poor throttle take-up, flat spot during acceleration.
- Engine missing (ignition, injection).
- Maximum engine power/top speed not reached.
- Fuel consumption too high.
- Engine running on.
- Engine pinging/knocking.
- Engine overheating.
- Fault lamp.

Cause (component fault)									
*			*						High-tension side
*									Firing sequence
*			*						Ignition coil
*									Ignition-distributor as-assembled setting
*									Voltage, trigger box
*									Voltage, primary circuit
*									Ignition-distributor plug and socket
*									DLS/impedance transformer
*									Voltage supply, magnetic pulse generator
*									Magnetic-pulse-generator function
*									Contact resistance (primary side)
*									Primary signal

TROUBLE-SHOOTING CHART (CONTINUED)

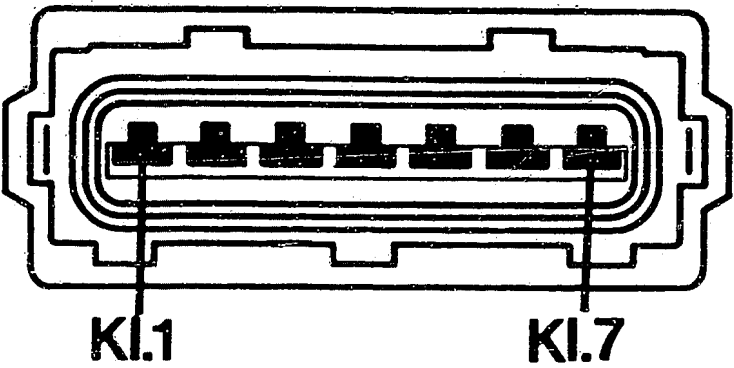
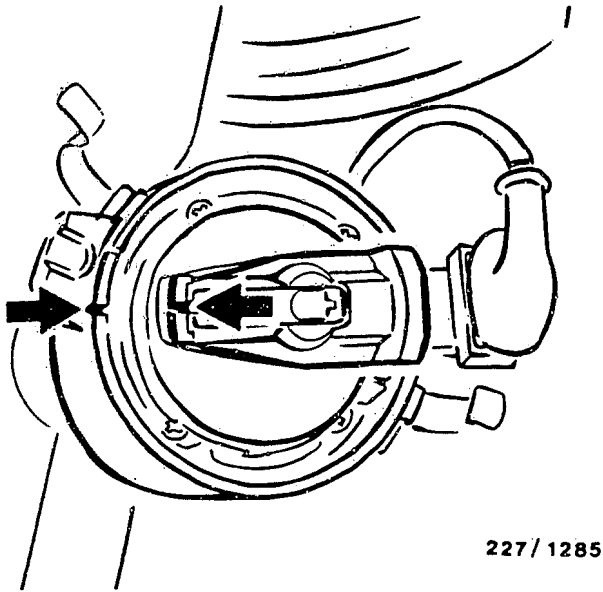
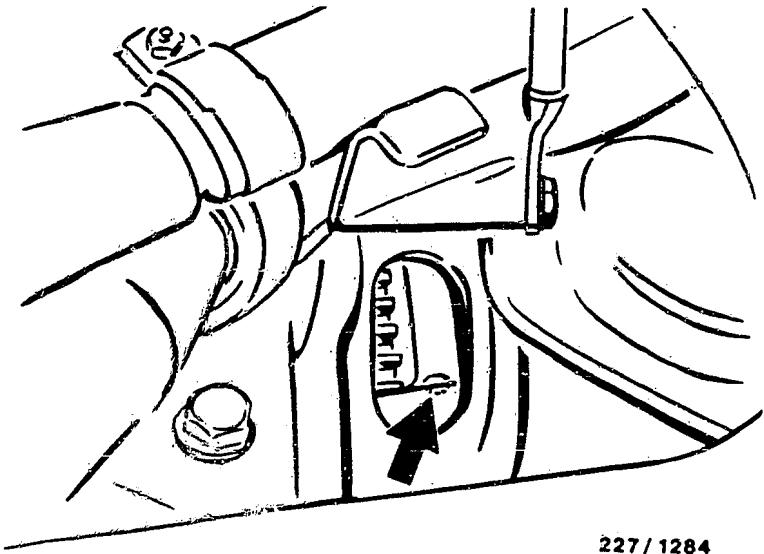
Customer complaint (fault symptoms)

- Starting motor operates, engine fails to start or starts only with difficulty.
- Engine starts but then dies.
- Idle problems (engine speed, exhaust gas).
- Poor throttle take-up, flat spot during acceleration.
- Engine missing (ignition, injection).
- Maximum engine power/top speed not reached.
- Fuel consumption too high.
- Engine running on (dieseling).
- Engine pinging/knocking.
- Engine overheating.
- Fault lamp.

Cause (component fault)									
*		*	*		*	*		*	Ignition point and ignition timing
				*					Voltage, trigger box (engine idling)
				*					Voltage, ignition coil (engine idling)
*									Peak-coil-current cutoff
				*					Primary voltage (engine idling)

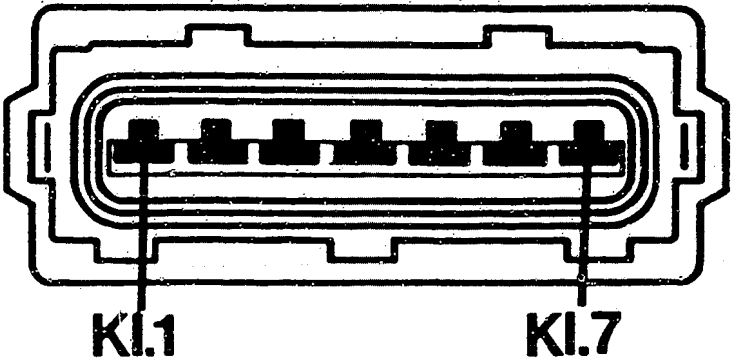
RAPID DIAGNOSIS CHART

Test step	Testing of component/function Test instructions/conditions	Terminals	Set values
1	HIGH-TENSION SIDE Test function for example of spark plugs, ignition harness and distributor cap (e.g. open-circuit, shunt). Assess for example by way of ignition oscillogram, resistance measurement, visual inspection.	—	—
2	FIRING SEQUENCE Test firing sequence, correct if necessary.	—	—
3	IGNITION COIL Visual inspection: plug present, sealing compound oozed out? Resistance, primary Resistance, secondary	<div>115 14</div>	<div>0,5...1,0 Ω 2,5...4,4 k Ω</div>
4	IGNITION-DISTRIBUTOR AS-ASSEMBLED SETTING Set cylinder 1 in compression stroke to TDC, distributor rotor points to mark on distributor housing.	—	<div>(Top picture)</div> <div>(Center picture)</div>
5	VOLTAGE, TRIGGER BOX Detach trigger-box plug. Voltage, trigger-box plug. See bottom picture. Ignition ON.	<div>42 (+)(-)</div>	Battery voltage

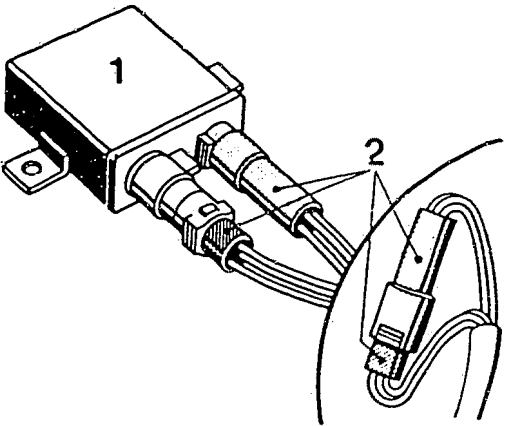


227/320/1

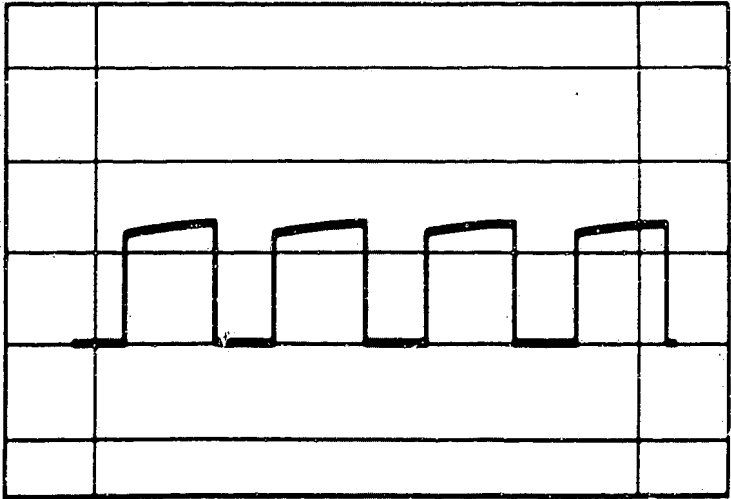
Test step	Testing of component/function Test instructions/conditions	Terminals	Set values
6	VOLTAGE, PRIMARY CIRCUIT Trigger-box plug is detached. Voltage, trigger-box plug. See top picture. Ignition ON.	1 2 (+) (-)	Battery voltage
7	IGNITION-DISTRIBUTOR PLUG AND SOCKET Visual inspection: Check plug and socket for oxidation.	—	—
8	DLS/IMPEDANCE TRANSFORMER (if applicable) Deactivate DLS/impedance transformer. Detach both connectors and connect them to one another. See center picture. 1 = DLS or impedance transformer 2 = Connector	—	—
9	VOLTAGE SUPPLY, MAGNETIC PULSE GENERATOR Ignition-distributor plug is attached. Voltage, ignition-distributor plug. Ignition ON.	3 5 (-) (+)	equal to/ greater than 10 V
10	MAGNETIC-PULSE-GENERATOR FUNCTION Oscilloscope "special" to ignition-distributor plug and vehicle ground. Actuate starting motor.	6 B- (+) (-)	Rectangular pulse (bottom picture)



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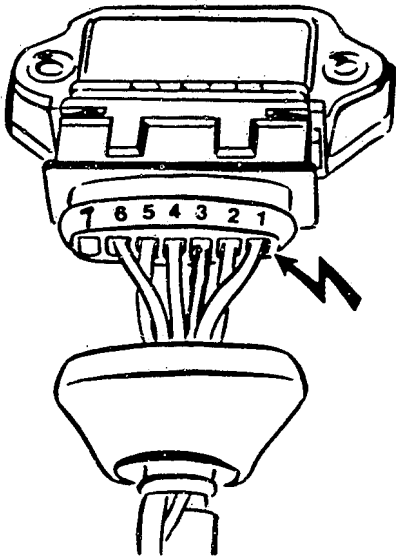
227/0064



227/0096

RAPID DIAGNOSIS CHART (CONTINUED)

Test step	Testing of component/function Test instructions/conditions	Terminals	Set values
11	<p>CONTACT RESISTANCE (primary side)</p> <p>Detach negative and positive lead from battery. Trigger-box plug is detached.</p> <p>Ignition ON. Resistance between battery terminal and trigger-box plug.</p> <p>Resistance between battery terminal and ignition coil.</p> <p>Resistance between ignition coil and trigger-box plug</p>	<p>B+ 4 B- 2</p> <p>B+ 15 1 1</p>	<p>max. 0.3 Ω</p> <p>max. 0.3 Ω</p>
12	<p>PRIMARY SIGNAL</p> <p>Attach trigger-box plug. Oscilloscope/engine-speed tester to ignition coil. Actuate starting motor.</p>	<p>15 1 (+) (-)</p>	<p>Primary voltage/ engine-speed reading (magnitude irrelevant)</p>
13	<p>IGNITION POINT AND IGNITION TIMING</p> <p>Connect Motortester in accordance with operating instructions.</p>	<p>—</p>	<p>See test specifications (e.g. Autodata)</p>
14	<p>VOLTAGE, TRIGGER BOX</p> <p>Push back rubber sleeve of trigger-box plug. Voltage, trigger-box plug. See top picture. Engine idling.</p>	<p>4 2 (+) (-)</p>	<p>12-14 V max. 1 V below U_B</p>



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RAPID DIAGNOSIS CHART (CONTINUED)

Test step	Testing of component/function Test instructions/conditions	Terminals	Set values
15	VOLTAGE, IGNITION COIL Voltage, ignition coil and battery. Engine idling.	15 B- (+) (-)	equal to/ greater than 10 V
16	PEAK-COIL-CURRENT CUTOFF Voltage, ignition coil. Ignition ON.	15 1 (+) (-)	after approx. 1 s 0 V.
17	PRIMARY VOLTAGE Oscilloscope with pulse-shaping circuit to ignition coil. Engine idling See top picture.	15 1 (+) (-)	340...400 V

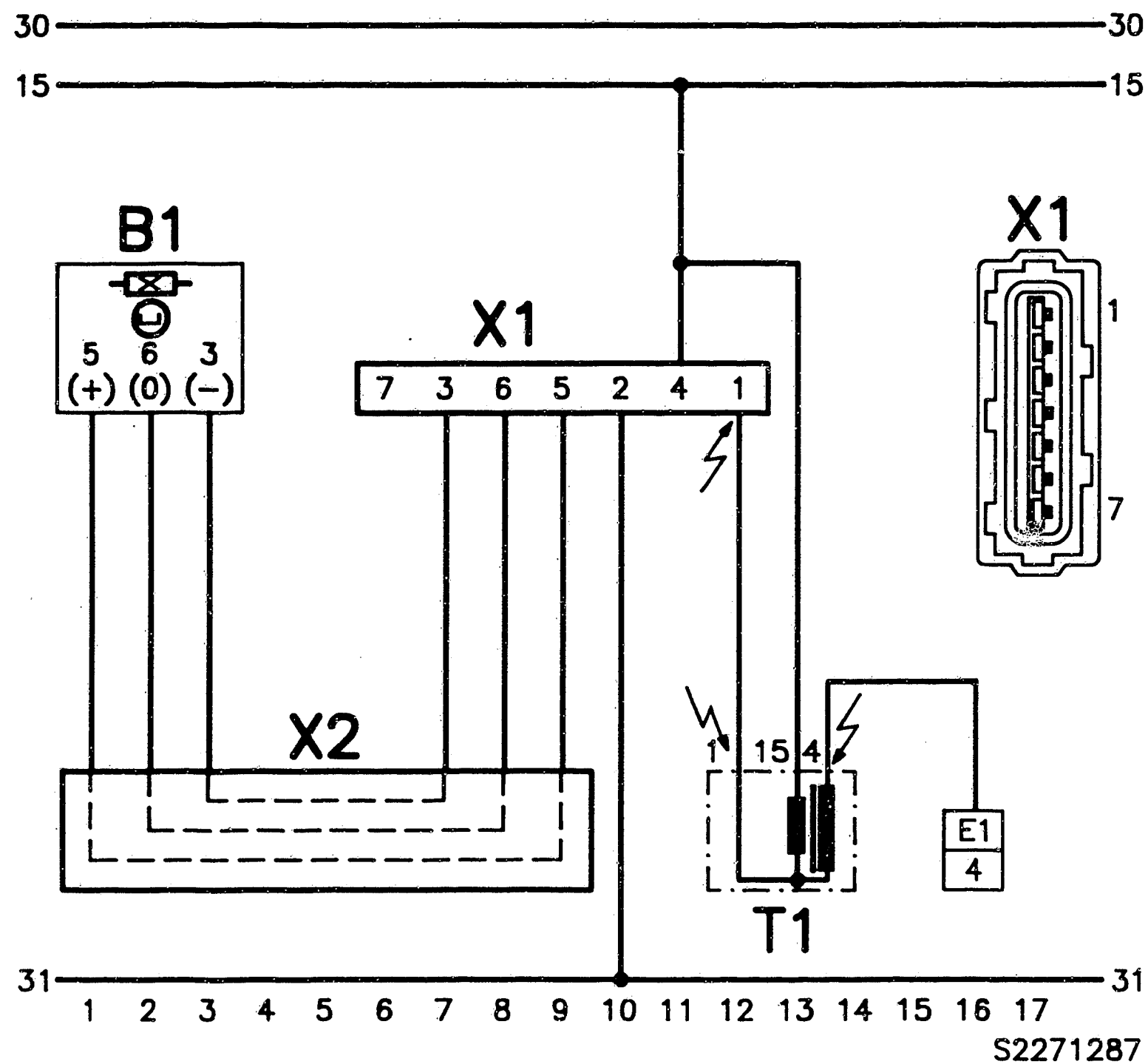


TEST SPECIFICATIONS

Ignition coil, primary	0,5...1,0 Ω
Ignition coil, secondary	2,5...4,4 k Ω
Voltage, trigger box with ignition ON	Battery voltage
Voltage, primary circuit with ignition ON	Battery voltage
Voltage supply, magnetic pulse generator with ignition ON	Equal to/ greater than 10 V
Magnetic-pulse-generator function at cranking speed	Rectangular pulse
Contact resistance Supply leads Trigger box or Primary circuit	max. 0.3 Ω
Primary signal at cranking speed	Primary voltage/ engine-speed reading
Ignition point and ignition timing	Test specifications e.g. Autodata
Voltage, trigger box with engine idling	12...14 V max. 1 V below U _B
Voltage, ignition coil with engine idling	Equal to/ greater than 10 V
Peak-coil-current cutoff Ignition ON	After approx. 1 s 0 V
Primary voltage with engine idling	340...400 V

Refer to Autodata test specifications for settings as regards idle speed, exhaust gas, valve clearance, etc.

For production reasons:
continued on the following
coordinate.



ELECTRICAL TERMINAL DIAGRAM

High-tension arrows: Caution 400 V...25 kV

B1 = Magnetic pulse generator (ignition distributor)

E1 = to ignition distributor

T1 = Ignition coil

X1 = Trigger-box plug

X2 = DLS or impedance-transformer
plug

INSTALLATION POSITION OF COMPONENTS

Ignition trigger box:

Make of vehicle:

AUDI 80 / 90 / 4000 / Coupe, -> 1987.

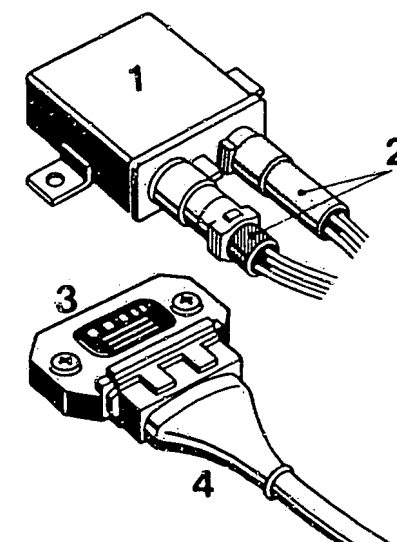
Trigger box, DLS or impedance transformer (where fitted) are located in the plenum chamber in the vicinity of the wiper motor (top picture) or in the glove compartment.

Make of vehicle:

AUDI 100 / 200 / 5000, -> 1987.

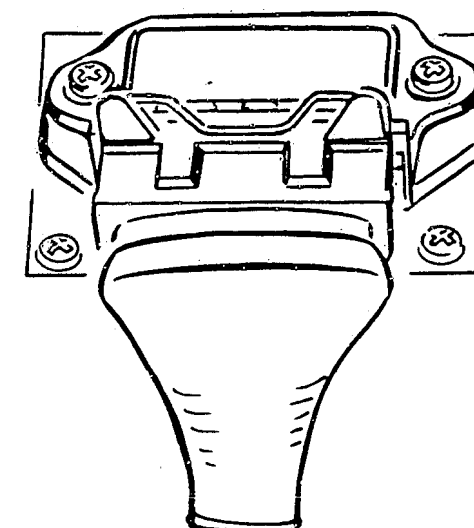
Trigger box, DLS or impedance transformer (where fitted) are located in the plenum chamber in the vicinity of the wiper motor (top picture) or beneath the trim of the A pillar in the front left footwell (bottom picture).

With vehicle makes as of model year 88, the trigger box is located beneath the trim of the A pillar in the front left footwell (bottom picture).



227/0042

- 1 = DLS or impedance transformer
- 2 = Connector
- 3 = TI-H trigger box
- 4 = Trigger-box plug



227/1288

Trouble-shooting instructions : BMW-5027
BOSCH system : Motronic M 1.2
Make of vehicle : BMW
Basic microcard : PKW-134

TABLE OF CONTENTS

<u>Section</u>	<u>Coordinates</u>
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Test specifications	15
Electrical terminal diagram	19
Installation position of components, notes on removal and installation	27

SPECIAL FEATURES

These trouble-shooting instructions, valid at the time of publication, apply to the following vehicle models:

- * BMW 750i/1L
with 5.0l/12 cylinder engine 10.87 ->
- * The V 12 engine is controlled by two Motronic control units and one EMS control unit.
Motronic 1: Cyl. 1...6 (in direction of travel right-hand cylinder bank, with cylinder 1 at front).
Motronic 2: Cyl. 7...12 (in direction of travel left-hand cylinder bank, with cylinder 7 at front).
- * Motronic systems M 1.2 with self-diagnosis (control units with 55-pole plugs).
- * The fault memory can be read out using the Pocket System Tester KTS 300 (0 684 400 300) with the program module PPG 204 as of status 09.01.89.

Note:
Further diagnosis possibilities (actuator diagnosis etc), which would be feasible with newer program-module statuses, are not evaluated with these vehicles.

Pay attention to operating instructions for KTS 300. Connection of the KTS 300 to the diagnosis socket in the vehicle is via the adapter lead 1 684 463 196 (BMW).
- * As an alternative to the KTS 300 (not possible with all control units) the self-diagnosis can be read out by way of a flashing code.
(Motronic, right: Flashing code 1xxx
Motronic, left: Flashing code 2xxx).
- * The self-diagnosis test table takes account of both the KTS 300 and the flashing code and is arranged according to fault code numbers indicated by the KTS 300.
The "fault indication" column sometimes includes two types of fault which are optionally indicated by the tester, e.g.: Open circuit/short-circuit to ground (= 1st type of fault)
Short to positive (= 2nd type of fault)

SPECIAL FEATURES (CONTINUED)

- * Control units with variant encoding.
Important:
Refer to basic instructions for ordering control units
- * Group injection: breakdown of each injection bank into 2 groups which inject at different times (except in warm-up phase and when accelerating). Synchronization by way of sensor on ignition cable of cyl. 6 or 12).
Group 1: Cylinders 1, 3, 5 or 7, 9, 11
Group 2: Cylinders 2, 4, 6 or 8, 10, 12
- * One Motronic control unit in each case controls one cylinder bank and is independent of the other Motronic control unit.
This means that all important system components such as air-mass meter, engine-speed/reference-mark sensor, lambda sensor, tank ventilation valve, high-tension sensor, temperature sensor for coolant (2 sensors or one twin sensor) and intake air, fuel pump and pressure regulator are doubled up.
- * Synchronization of cylinder banks and idle speed regulation is effected by the EMS control unit (BMW designation: EML).
- * Adaptive lambda control and tank ventilation with active carbon filter and two pulsed tank ventilation valves (for cat.).
- * Control units have built-in hold circuits (for tank ventilation valves).

SPECIAL FEATURES (CONTINUED)

Information on trouble-shooting:

1. Adaptive lambda control.

Note:

If the engine does not start following elimination of fault (e.g. after replacing lambda sensor or injection valves or after eliminating leaks in intake system or exhaust system), detach Motronic control-unit plug with ignition switched off for a brief period (min. 10 seconds). This cancels the adaption values. Then attempt to start again.

- #### 2. If the code for depriving the burglar alarm was entered incorrectly or if there is a defect in the vehicle computer/burglar alarm, positive is switched to term. 38 of the Motronic control units. The engine can then not start. For rapid testing, disconnect vehicle computer and alarm module and attempt to start again (no voltage at term. 38).

SELF-DIAGNOSIS TEST TABLE

Pocket system tester Fault indication	Fault code	Flash- ing code	Test instructions/test conditions	Terms.	Set values
Data exchange not possible	—	—	Prerequisite for fault output: leads between control units and diagnosis unit or fault lamp (flashing code) and voltage supply for control unit(s) O.K. Note: Fault lamp is only installed in instrument panel on US models (CARB lamp).	13 55 15	—
Control unit Digital sec. (comput) defective	01	1211 2211	Control unit defective.	—	—
Relay Fuel pump Op.circ/sh. to grnd. Short to B+	03	1261 2261	Fault 1: Open circuit (op. circ) short to ground. (sh. to grnd.) Fault 1 is only recognized if other output stages are defective. Fault 2: Short to positive (short to B+) Detach pump relay and measure voltage (with respect to ground) in frame (term. 86) with ignition on: Resistance of relay coil (term. 85/86): Test lead to control unit (term. 3).	3	10...15 V approx. 50...150 Ω
Valve Tank ventilation Op.circ/sh. to grnd. Short to B+	05	1263 2263	Only CAT models have a tank ventilation valve. Check lead for contact with ground or positive. Valve winding resistance at +15 ... +30°C: If lead and valve O.K., control unit is defective. Open circuit (op. circ) is not recognized!	5	35... 55 Ω
Air-flow sensor/ Air-mass sensor Signal too low Signal too high	07	1215 2215	Signal too low: Check leads to air-mass sensor term. 4 (signal) and term. 2 (battery voltage) for open circuit and lead to term. 4 for short to ground. Signal too high: Check lead to air-mass sensor term. 4 for short to positive and both ground leads (term. 5 and term. 6) for open circuit. Check resistances of air-mass sensor: between term. 5 and term. 6 (ground terminals) between term. 4 and term. 5 (shunt): Air-mass sensor defective.	7(S)* 37(+) 26(-) 2.grnd.	— 0 Ω 2,5...3,1 Ω

*) S = Signal

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flash- ing code	Test instructions/test conditions	Terms.	Set values
Lambda control outside min. range outside max. range	10	1222 2222	Check CO cont. of both cyl. banks ahead of cataly. conv. Check intake system and exhaust system for leaks. Check fuel pressure. Injection valve(s) not functioning. Sensor defective.	—	—
Fault lamp Op.circ/sh. to grnd. Short to B+	15	— —	Check lead to fault lamp for short to ground. (sh. to grnd.) and short to positive (short to B+). Open circuit (op. circ) is not recognized! Note: Fault lamp is only installed on US models in instrument panel (CARB lamp).	15	—
Injectors (Group 2) Op.circ/sh. to grnd. Short to B+	16	1251 2251	Fault: Short to ground (sh. to grnd.), to positive (B+) or open circuit (op. circ) in joint positive/negative lead. Check injectors of cyl. 1, 3, 5 (right-hand bank) and of cyl. 7, 9, 11 (left-hand bank) for short circuit or open circuit (op. circ). If injectors and leads ok, the corresponding control unit is defective. Note: Open circuits (op. circ) in individual injectors are not recognized (see basic instructions).	16	4,8...5,7 Ω (3 valves in parallel) 14...17,5 Ω (1 injector)
Injectors (Group 1) Op.circ/sh. to grnd. Short to B+	17	1252 2252	Fault: Short to ground (sh. to grnd), to positive (B+) or open circuit in joint positive/negative lead. Check injectors of cyl. 2, 4 6 (left-hand bank) and of cyl. 8, 10, 12 (right-hand bank) for short circuit or open circuit (op. circ). If injectors and leads ok, the corresponding control unit is defective. Note: Open circuits (op. circ) in individual injectors are not recognized (see basic instructions).	17	4,8...5,7 Ω (3 valves in parallel) 14...17,5 Ω (1 injector)

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flash- ing code	Test instructions/test conditions	Terms.	Set values
Relay Sensor heater Op.circ/sh. to grnd. Short to B+	23	1264 2264	Check lead from control unit term. 23 to relay term. 85 for open circuit (op.circ), short to ground (sh. to grnd.) and short to positive (B+). Detach sensor heater relay and measure volt. (with respect to grnd.) in frame (term. 86) with ign. switched on Resistance of relay coil (term. 85/86):	23	10...15 V approx. 50... 150 Ω
Lambda sensor Open circuit Short to ground Short to B+	28	1221 2221	Check lead for open-circuit (op.circ), short to ground and short to positive (B+). Watch out for worn insulation! Sensor heater defective. Sensor clogged.	28	—
Battery voltage too low too high	37	1231 2231	Supply voltage for control unit too low: Check voltage dips at positive and ground terminal. Charge battery. Supply voltage for control unit too high: Check alternator regulator.	37 19 (+) (-)	greater than 9 V (with engine running) less than 16 V (with engine running)
ASR/MSR interface Short to B+	38	— —	Check lead between Motronic and ABS/ETC/MSR control unit and/or burglar alarm for short to positive (B+) If leads and plug connections are ok, continue trouble-shooting with ETC/MSR or burglar alarm.	38	—
Air temp. sensor Op.circ./sh.to B+ Short to ground	44	1224 2224	Check temperature sensor and lead for open circuit (op.circ.), short to ground and short to positive (B+) Temperature-sensor resistance at +15...+30°C:	44	1450...3300 Ω
Engine temp. sensor Op.circ./sh. to B+ Short to ground	45	1223 2223	Check temperature sensor and lead for open circuit (op.circ.), short to ground and short to positive (B+). Temperature-sensor resistance: at +15...+30°C: at approx. +80°C:	45	1450...3300 Ω 280... 360 Ω
Transmission identification Short to ground	51	1278 2278	Check lead for short to ground or corresponding output in transmission control unit is defective.	51	—

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flash- ing code	Test instructions/test conditions	Terms.	Set values
Idle switch Short to ground	52	1232 2232	Fault 1: Short to ground in lead to EMS control unit term. 6 (left-hand cylinder bank) or term. 32 (right-hand cylinder bank) or short to ground in lead between EMS control unit term. 6 and throttle sensor. Fault 2: EMS control unit defective (output stage failure).	52	_____
Full-load switch Short to ground	53	1233 2233	Fault 1: Short to ground in lead to EMS control unit term. 5 (left-hand cylinder bank) or term. 33 (right-hand cylinder bank). Fault 2: EMS control unit defective (output stage failure).	53	_____
Converter clutch/ Driving pos. switch Comparison not O.K.	54 (24)	_____ _____	Note: Fault code 24 corresponds to fault code 54 Check lead between Motronic term. 54 and transmission control term. 25 for short to ground. If lead is ok, continue trouble-shooting with transmission control.	54	_____
CU output stages with fin. cntling el. defective	100	_____ _____	CU = Control unit Check following components and leads for open circuit, short to ground and short to positive: Injectors, fuel pump relay and sensor heater relay, tank ventilation valve, fault lamp (US only).	16 17 3 23 5 15	_____
No fault stored	—	1444 2444	Continue trouble-shooting with trouble-shooting chart	_____	_____
_____	—	1000 2000	End of output (flashing code only)	_____	_____

TEST SPECIFICATIONS

Pressure regulator	
Fuel pressure	2,8...3,2 bar
Electric fuel pump	
Delivery	
(measured in return line)	min. 1150 cm ³ /30s
Supply voltage	
(under load):	min. 12 V

Temperature sensor (intake air)	
Internal resistance	
at ambient temperature	
(+15°C...+30°C):	1450...3300 Ω

Temperature sensor (engine)	
Plug colour blue.	
Internal resistance at	
ambient temperature	
(+ 15° C...+ 30° C):	1450...3300 Ω
Operating temperature	
(approx. + 80° C):	280... 360 Ω

Solenoid-operated injection valve	
Internal resistance	
at ambient temperature	
(+ 15° C...+ 30° C):	14...17,5 Ω

Hot-wire air-mass meter	
Internal resistance between	
term.5 and term.4 (ground terminals):	0 Ω
term.6 and term.4 (shunt)	2,5...3,1 Ω
term.3 and term.4 (CO poti)*:	0...1100 Ω

(*) CO potentiometer is only active on models
with no lambda closed-loop control.

TEST SPECIFICATIONS (CONTINUED)

Engine-speed/reference-mark sensor	
Internal resistance	
between term.1 and term.2 at ambient	
temperature (+15°C...+30°C):	400...800 Ω
Air gap:	0,8 ± 0,5 mm

Lambda sensor	
Resistance of heater winding	
(sockets 3 and 4 in 4-pole pin	
terminal to lambda sensor)	1... 15 Ω

Ignition coil	
Primary resistance:	approx. 0,5 Ω
Secondary resistance:	
Bar-type coil	4300... 7700 Ω
Plastic coil (new)	6500...11500 Ω

Interference-suppression resistors	
H.T. distributor rotor:	1 k Ω
H.T. distributor domes:	each 1 k Ω
Spark-plug connector:	each 5 k Ω
Spark plugs:	5 k Ω
Ignition coil:	1 k Ω

TEST SPECIFICATIONS (CONTINUED)

H.T. sensor:

Internal resistance

between term.1 and term. 2: approx. 0,2...1,0 Ω

Tank ventilation valve:

(in catalytic converter vehicles only)

Internal resistance at

ambient temperature (+15°C...+30°C): 35...55 Ω

Idle test:

Engine at operating temperature,
switch off loads.

Idle speed: 700 \pm 50 min⁻¹

Ignition angle: 15 \pm 5° CS

(Automatic transmission on N or P)

CO content (without lambda closed-loop control): 1,0 \pm 0,5
vol.% CO

Effect mixture setting at bypass screw in air-flow sensor:

To the left = leaner mixture

To the right = richer mixture.

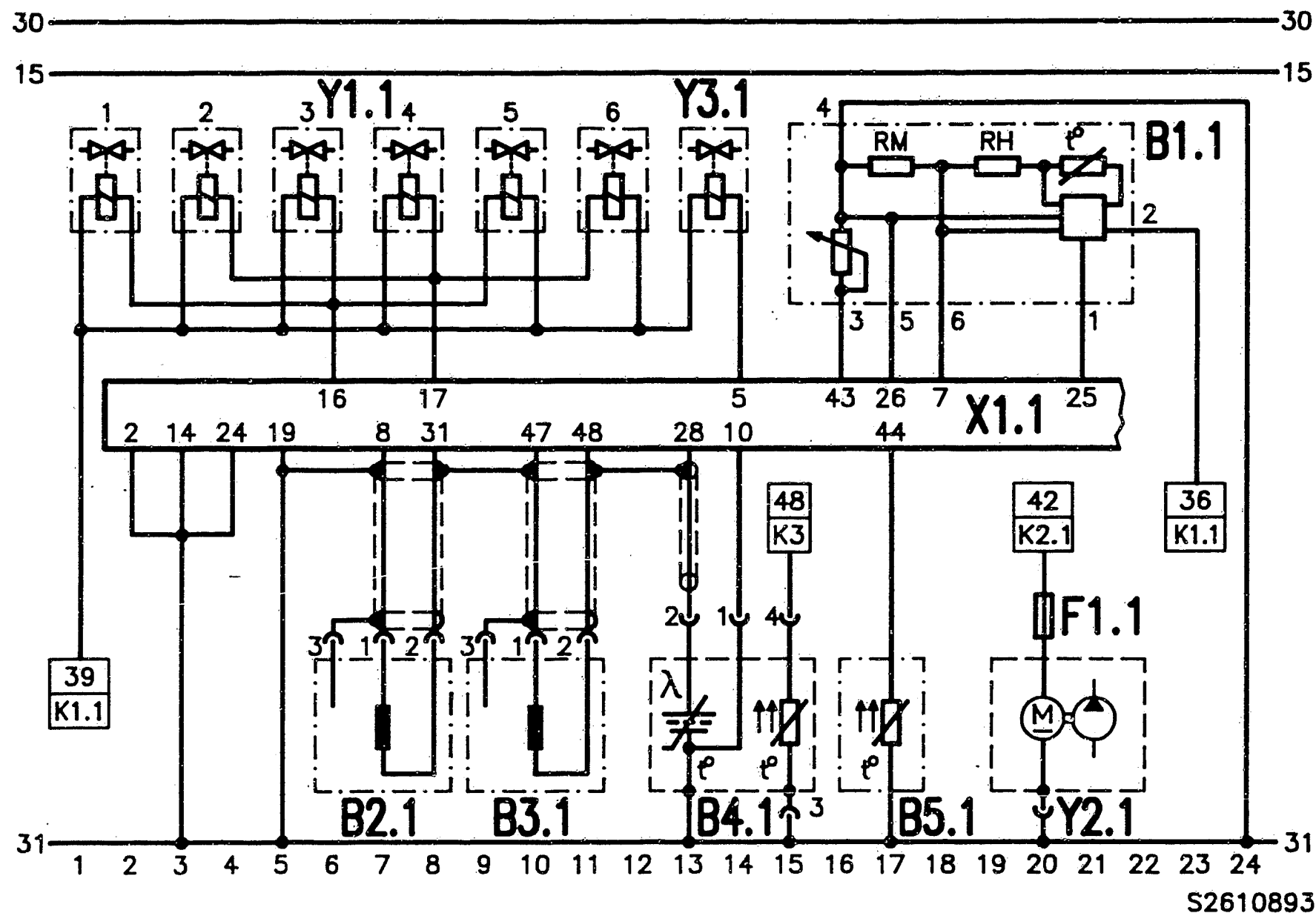
CO content (with lambda closed-loop control): 0,7 \pm 0,5
vol.% CO

(Measure CO ahead of catalytic converter if
sampling point provided).

(per cylinder
bank)

Please refer to equipment and Autodata
microcard for settings as regards valve
clearance and other engine-related data.

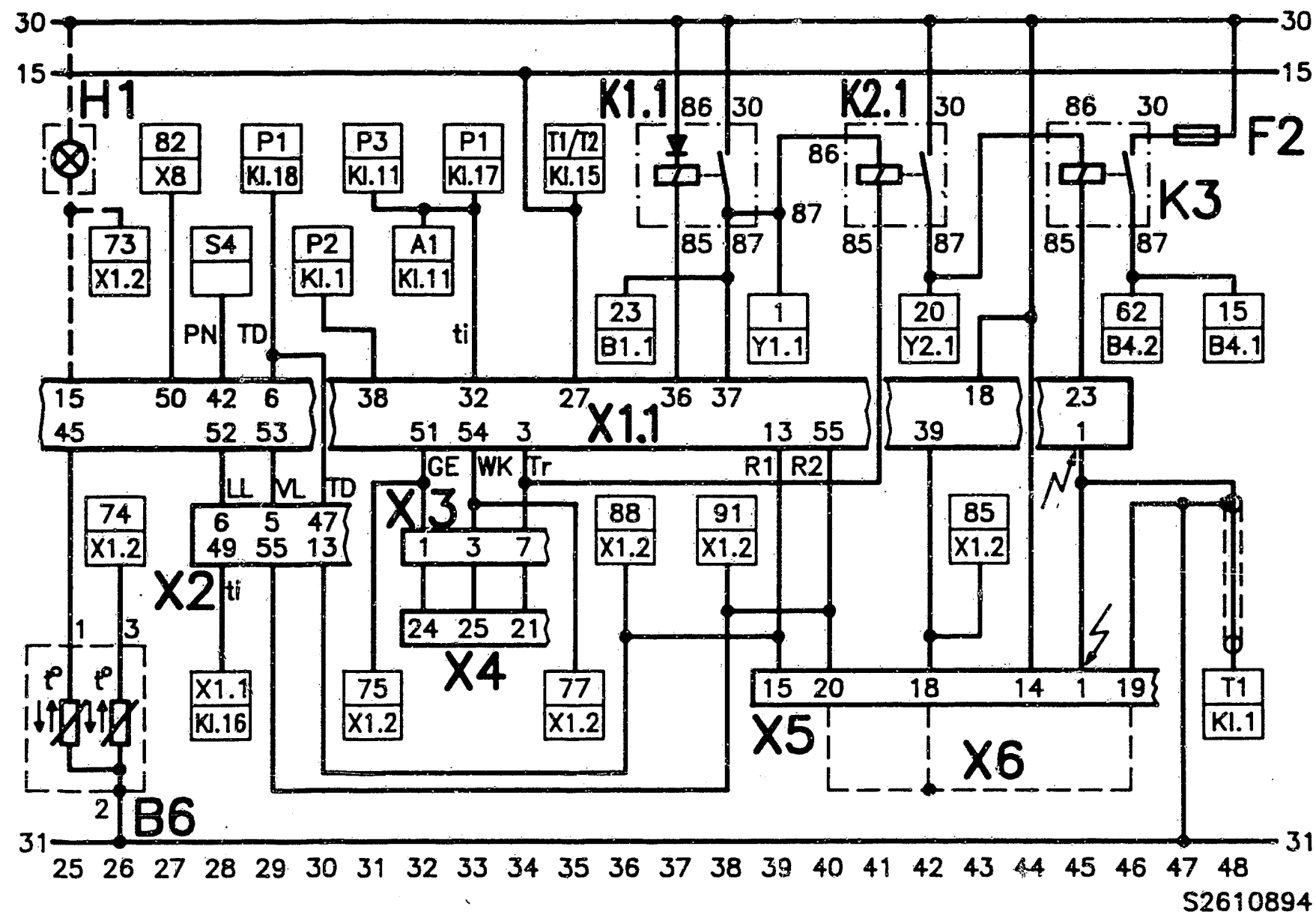
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coordinate.



ELECTRICAL TERMINAL DIAGRAM

B1.1 = Air-mass meter 1 (cylinders 1...6)
 B2.1 = H.T. sensor 1
 B3.1 = Engine-speed/reference mark sensor 1
 B4.1 = Heated lambda sensor 1 (cat)
 B5.1 = Temperature sensor 1 (air)
 F1.1 = Pump fuse 1 (No. 23)
 Y3.1 = Tank ventilation valve 1 (cat)

K1.1 = Main relay 1
 K2.1 = Pump relay 1
 K3 = Sensor heater relay (cat)
 X1.1 = Motronic 1 control-unit plug
 Y1.1 = Solenoid-operated injection valves (cylinders 1...6)
 Y2.1 = Electric fuel pump 1

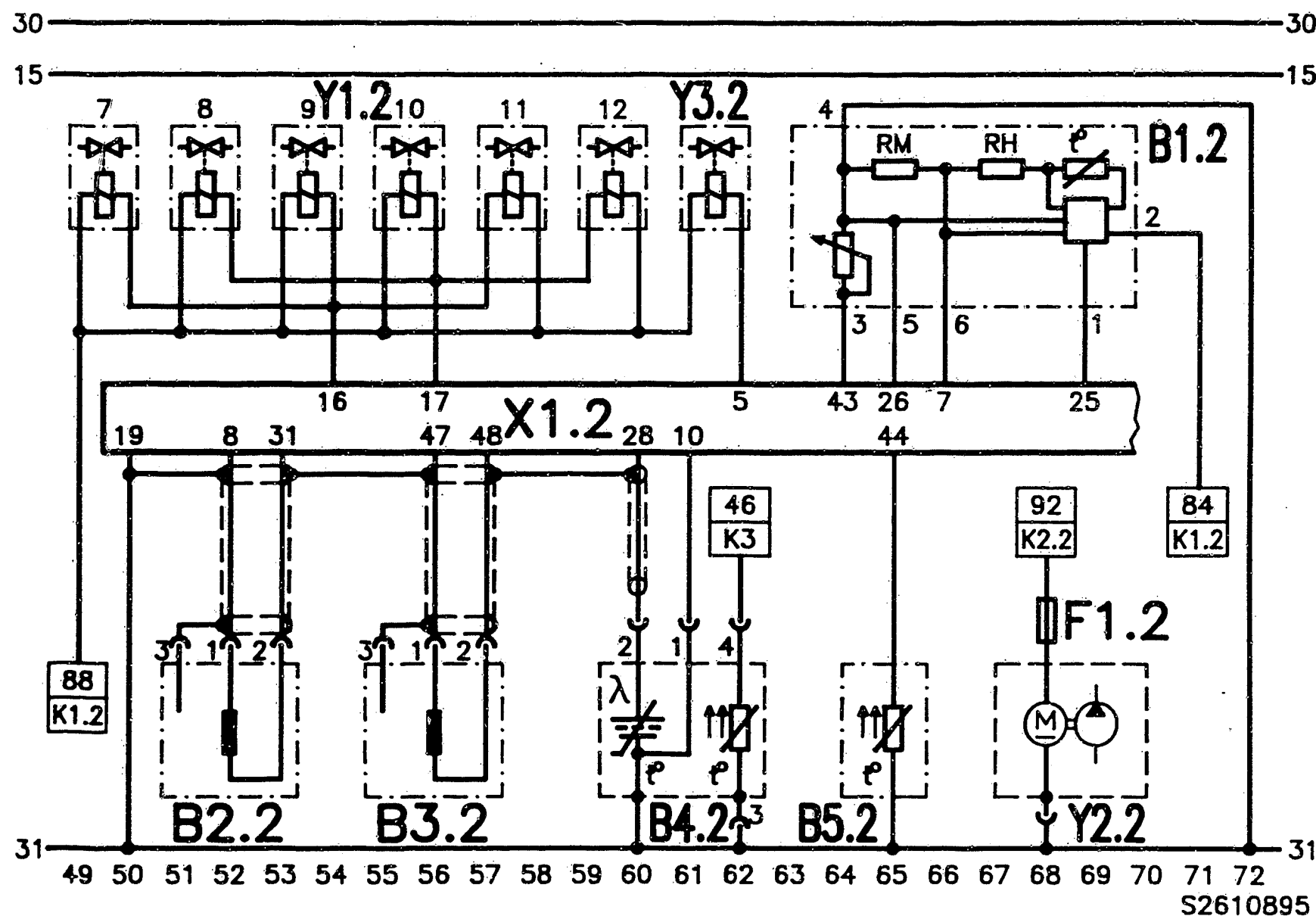


ELECTRICAL TERMINAL DIAGRAM (CONTINUED)

A1 = TC control unit
(TC = transmission control)
B6 = Engine temperature sensor
F2 = Sensor heater fuse
H1 = "CARB" lamp (fault lamp;
US version only)
K1.1 = Main relay 1
K2.1 = Pump relay 1
K3 = Sensor heater relay (cat)

P1 = Instrument cluster/
Check Control
P2 = Burglar alarm
P3 = Vehicle computer
R1 = Stimulation lead
R2 = Serial interface
S4 = Driving position switch
T1 = Ignition coil 1
T2 = Ignition coil 2
X8 = ABS/ETC/MSR-
control-unit plug

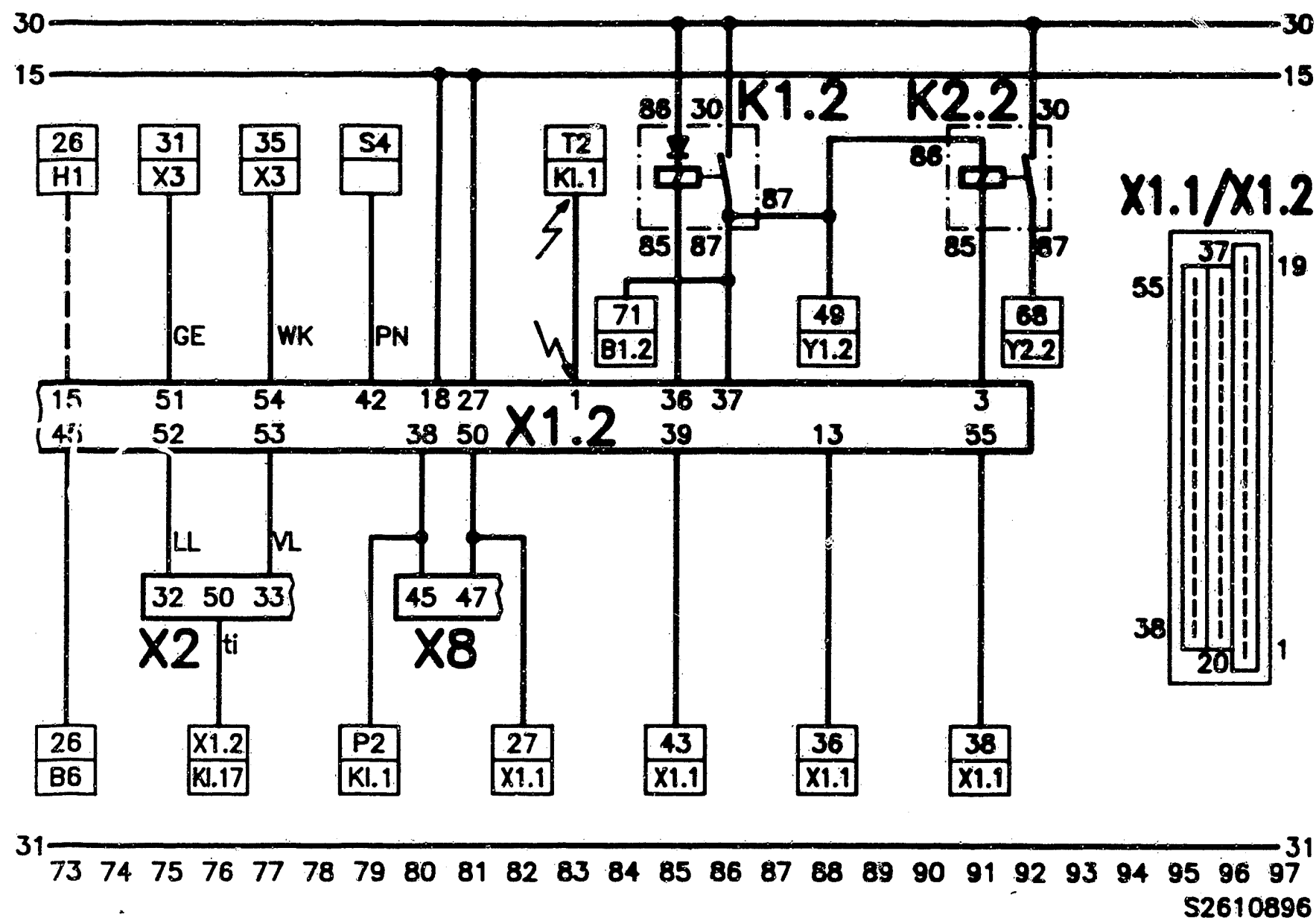
X1.1 = Motronic 1 control
unit plug
X1.2 = Motronic 2 control
unit plug
X2 = EMS control-unit plug
X3 = Plug connection to TC
X4 = TC control-unit plug
X5 = Diagnosis unit
X6 = Jumper in cover



ELECTRICAL TERMINAL DIAGRAM (CONTINUED)

B1.2 = Air-mass meter 2 (cylinders 7...12)
 B2.2 = H.T. sensor 2
 B3.2 = Engine-speed/reference-mark sensor 2
 B4.2 = Heated lambda sensor 2 (cat)
 B5.2 = Temperature sensor 2 (air)
 F1.2 = Pump fuse 2 (No. 24)
 Y3.2 = Tank ventilation valve 2 (cat)

K1.2 = Main relay 2
 K2.2 = Pump relay 2
 K3 = Sensor heater relay (cat)
 X1.2 = Motronic 2 control-unit plug
 Y1.2 = Solenoid-operated injection valves (cylinders 7...12)
 Y2.2 = Electric fuel pump 2

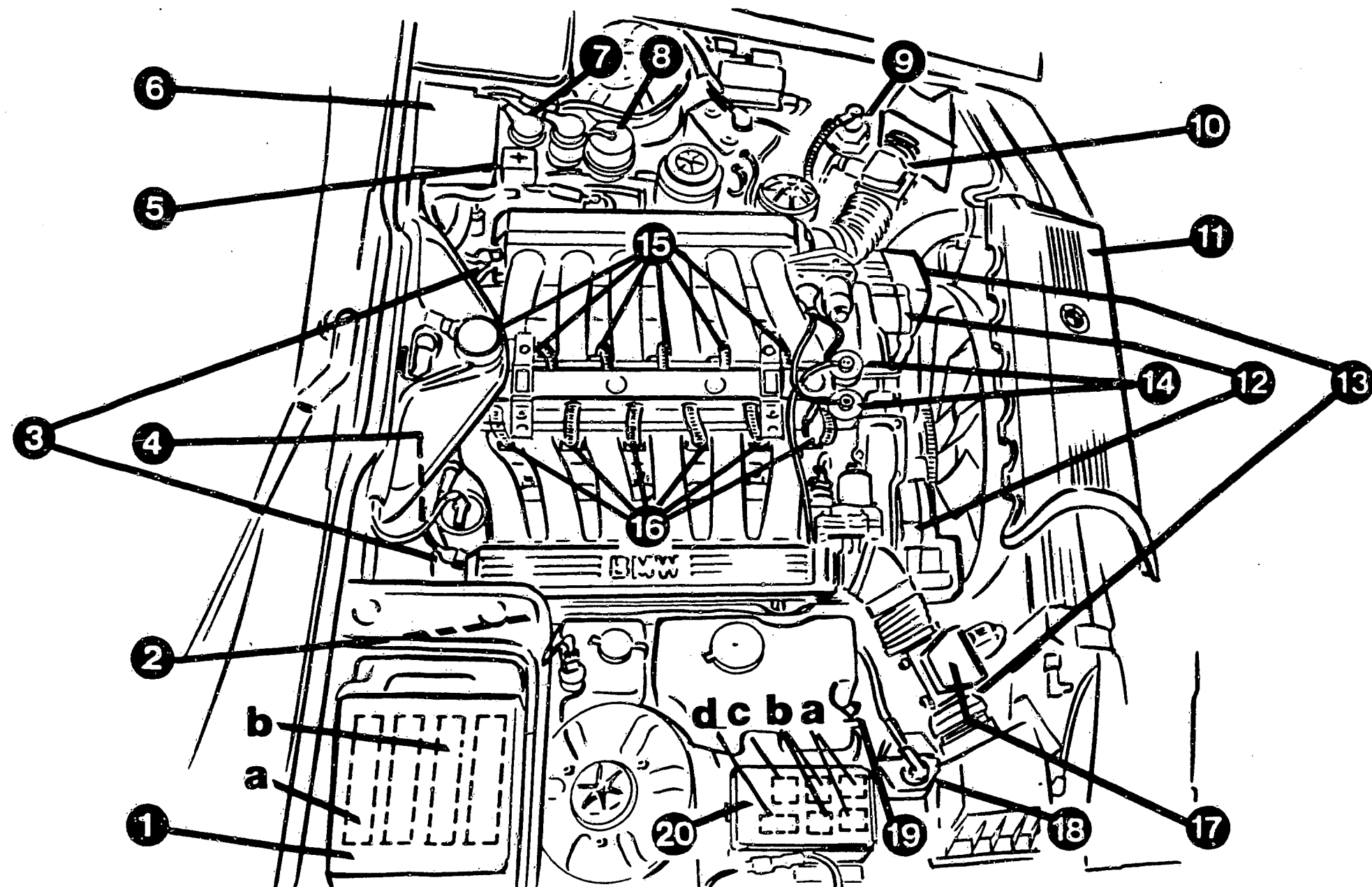


ELECTRICAL TERMINAL DIAGRAM (CONTINUED)

B1.2 = Air-mass meter 2
(cylinders 7...12)
B6 = Engine temperature sensor
H1 = "CARB" lamp (fault lamp;
US version only)
K1.2 = Main relay 2
K2.2 = Pump relay 2
P2 = Burglar alarm

S4 = Driving position switch
T2 = Ignition coil 2
X1.1 = Motronic 1 control
unit plug
X1.2 = Motronic 2 control
unit plug
X2 = EMS control-unit
plug

X8 = ABS/ETC/MSR-
control-unit plug
Y1.2 = Solenoid-operated injection valves
(cylinders 7...12)
Y2.2 = Electric fuel pump 2



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INSTALLATION POSITION OF COMPONENTS

1 = Control-unit box with:
 a= Motronic 1 control unit
 (right-hand cylinder bank)
 b= Motronic 2 control unit
 (left-hand cylinder bank)
 2 = Motronic ground terminals
 3 = Air temperature sensor (2)
 4 = Engine temperature sensor
 (2 sensors or twin sensor)
 5 = Battery positive terminal
 6 = Fuse box
 7 = Engine plug

8 = Diagnosis unit
 9 = Ignition coil 2
 10 = Hot-wire air-mass meter 1
 11 = Cover over injection
 valves (removed)
 12 = H.T. distributor (2)
 13 = Tank ventilation valves
 (at air filter housings)
 14 = Pressure regulator (2)
 15 = Injection valves cyl. 7...12
 16 = Injection valves cyl. 1...6
 17 = Hot-wire air-mass meter 2

18 = Ignition coil 1
 19 = Active-carbon filter
 20 = Relay box with:
 a= Main relay (2)
 b= Fuel pump relay (2)
 c= Sensor heater relay
 d= 8-pole plug connection
 to transmission control

Note: Items a) and b) can
 be interchanged.

Trouble-shooting instructions : FOR-5006
BOSCH system : EI
Make of vehicle : FORD
Basic microcard : PKW-131

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SPECIAL FEATURES

These brief instructions, valid at the time of publication, apply to the following Ford model:
Escort, Orion 1.6 l with catalytic converter as of 04.88
engine: 1.6 l / 4 cyl.

- * EI system with self-diagnosis and 25-pole control-unit plug.
- * EI control unit 0 227 400 044
- * Trigger box 0 227 100 124
(with current limitation)
- * Ignition coil 1 227 020 017
- * Ignition coil with trigger box 0 221 600 010
- * Ignition distributor 0 237 521 ...

NOTE :

Vehicles, which were supplied between 1.88 and 4.88, may be equipped with a RATIO EI control unit. This RATIO EI control unit has the standard part number 0 227 400 101 and is identical in terms of function to the EI control unit 0 227 400 044.

Recognition of these vehicles:
Fitted with EI control unit 0 227 400 101, however without knock sensor and temperature sensor (intake air).

STRUCTURE AND USAGE

Tnese brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

Identical test-step numbering makes it easier to find individual test steps in brief and basic instructions.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

TROUBLE-SHOOTING CHART

Customer complaint (fault symptoms)

1. Starting motor operates, engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Idle problems (engine speed, exhaust gas).
4. Poor throttle take-up, flat spot during acceleration.
5. Engine missing (ignition, injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on.
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

							Cause (component fault)
*							* Self-diagnosis
*	*	*	*	*	*		High-tension side
*	*	*	*	*			Ignition coil
*	*						Firing sequence
*							Ignition-distributor as-assembled setting
*							Voltage, EI control unit
*							Voltage, trigger box
*							Voltage, primary circuit
*							Ignition-distributor plug and socket
*							Magnetic pulse generator, voltage supply
*							Magnetic pulse generator, function
*							EI control-unit function
*							Contact resistances
*							Primary signal
	*	*		*	*	*	Temperature sensor (coolant)

TROUBLE-SHOOTING CHART (CONTINUED)

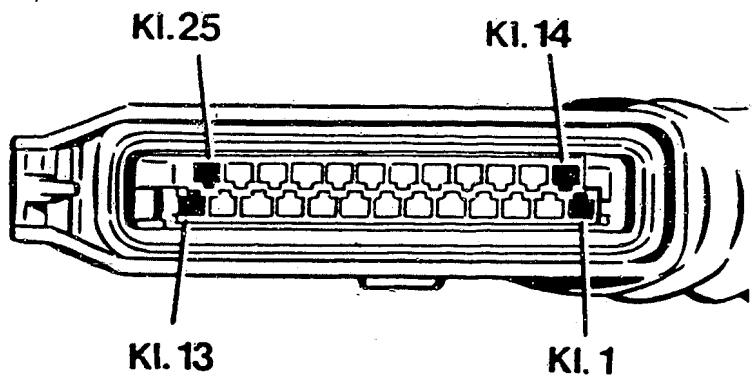
Customer complaint (fault symptoms)

1. Starting motor operates, engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Idle problems (engine speed, exhaust gas).
4. Poor throttle take-up, flat spot during acceleration.
5. Engine missing (ignition, injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

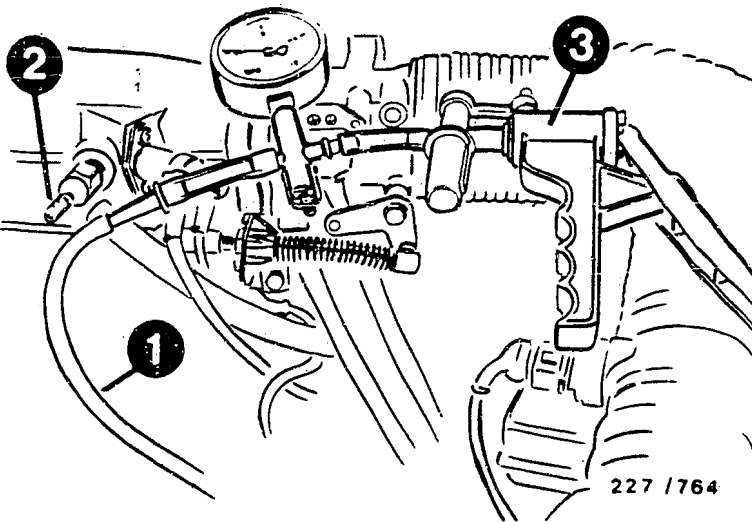
									Cause (component fault)
						*			Microswitch (idle contact)
	*	*		*	*	*	*		Basic ignition setting
	*								Solenoid valve (idle compensation)
		*		*	*	*			Vacuum sensor, EI control unit
			*						Voltage, ignition coil (engine idling)
			*						Primary voltage (engine idling)

SELF-DIAGNOSIS TEST TABLE

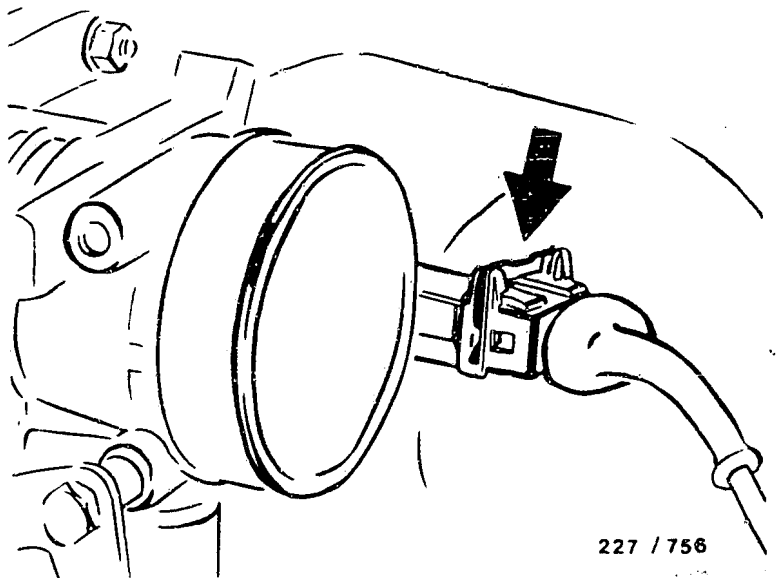
Fault indication Flashing code	Testing of component/function Test instructions/conditions	Termi- nals	Set values
2	TEMPERATURE SENSOR (COOLANT) Detach EI control-unit plug. Resistance, EI control-unit plug and vehicle ground. See top picture.	25 B-	+20° C 2,1...3,0 k Ω +30° C 1,4...2,0 k Ω +80° C 280...380 Ω +90° C 210...280 Ω +100° C 160...220 Ω
5	EI CONTROL UNIT (LOAD SENSOR) Detach vacuum hose (1) from intake manifold (2) and connect to vacuum pump (3) (see center picture). Detach microswitch plug connection (idle contact). See bottom picture (arrow) Allow engine to idle and establish ignition angle. Build up approx. 500 mbar pressure with vacuum pump.		Ignition angle must be "advanced".



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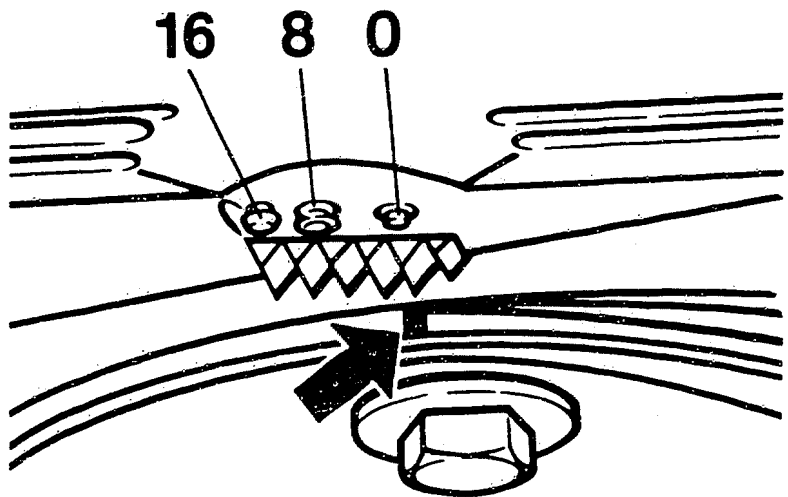
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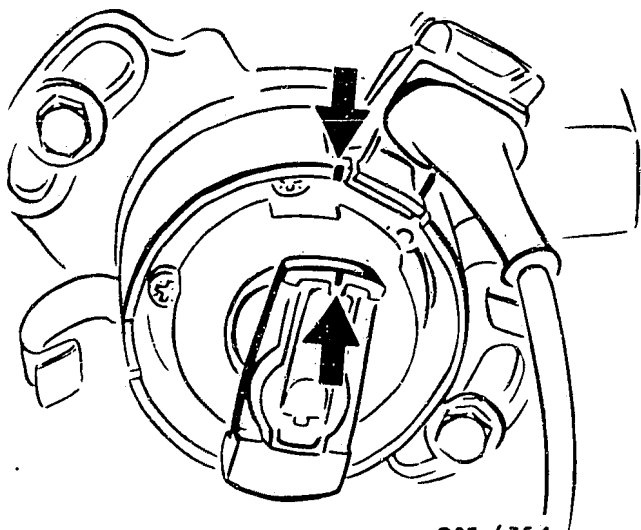
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RAPID DIAGNOSIS CHART

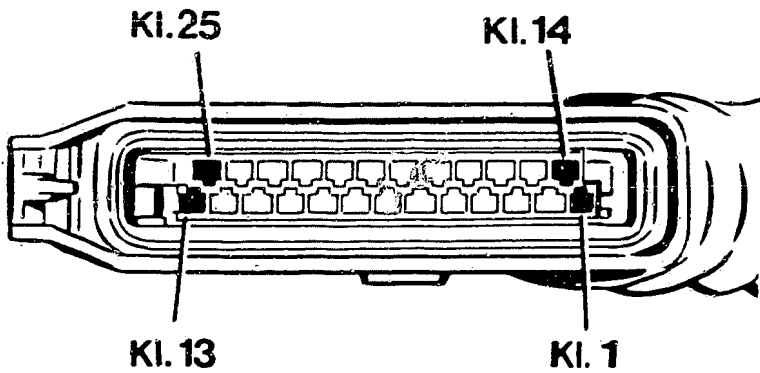
Test step	Testing of component/function Test instructions/conditions	Termi- nals	Set values
1	HIGH-TENSION SIDE Test function for example of spark plugs, ignition harness and distributor cap (e.g. open-circuit, shunt). Assess for example by means of ignition oscillogram, resistance measurement, visual inspection.	—	—
2	IGNITION COIL Resistance, primary Resistance, secondary	1 15 1 4	0,6... 1,1 Ω 6,4...11,1 k Ω
3	IGNITION-DISTRIBUTOR AS-ASSEMBLED SETTING Set cylinder 1 in compression stroke to 0° = TDC. Distributor rotor points to mark on distributor housing.		(Top picture) (Center picture)
4	VOLTAGE, EI CONTROL UNIT Detach EI control-unit plug. Voltage, EI control-unit plug. See bottom picture. Ignition ON.	6 20 (+) (-)	Battery voltage



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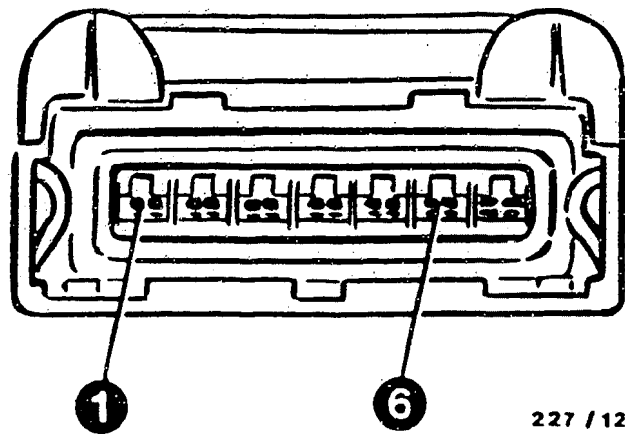
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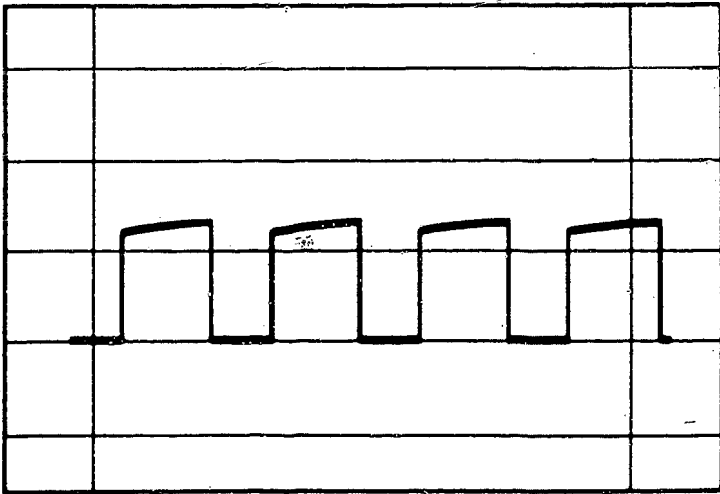
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RAPID DIAGNOSIS CHART (CONTINUED)

Test step	Testing of component/function Test instructions/conditions	Termi- nals	Set values
5	VOLTAGE, TRIGGER BOX Detach trigger-box plug. Voltage, trigger-box plug. See top picture. Ignition ON.	4 (+) 2 (-)	Battery voltage
6	VOLTAGE, PRIMARY CIRCUIT Trigger-box plug is detached. Voltage, trigger-box plug. See top picture. Ignition ON.	1 (+) 2 (-)	Battery voltage
7	IGNITION-DISTRIBUTOR PLUG AND SOCKET Visual inspection: Check plug and socket for oxidation.	—	—
8	VOLTAGE SUPPLY, MAGNETIC PULSE GENERATOR Ignition-distributor plug is attached. Voltage, ignition-distributor plug. Ignition ON.	10 (-) 4 (+)	Equal to/greater than 10 V
9	MAGNETIC-PULSE-GENERATOR FUNCTION Oscilloscope "Special" to ignition-distributor plug and vehicle ground. Actuate starting motor.	24 B- (+) (-)	Rectangular pulse (bottom picture)



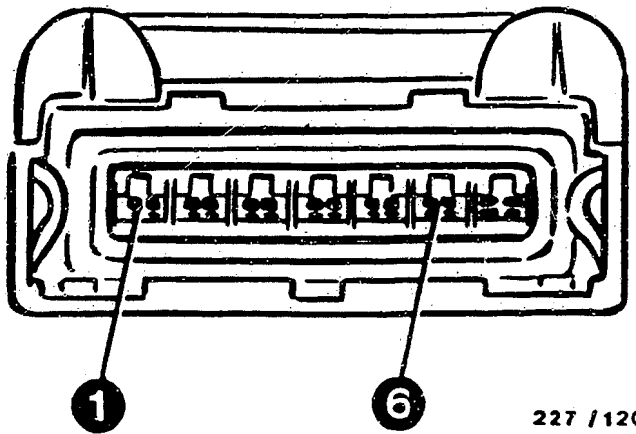
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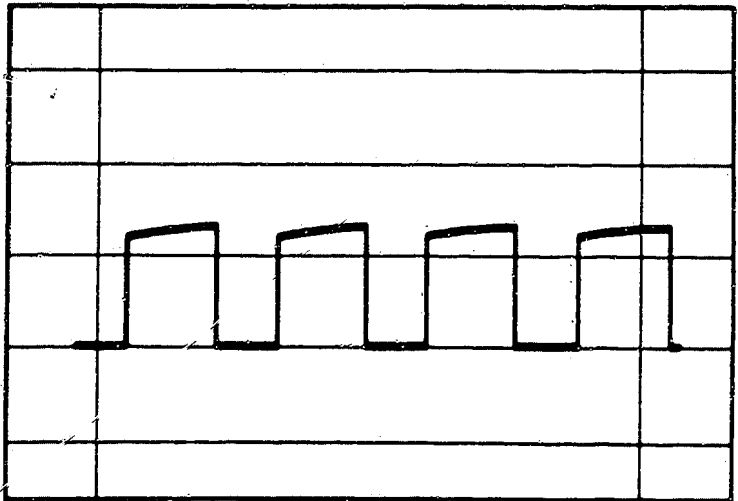
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RAPID DIAGNOSIS CHART (CONTINUED)

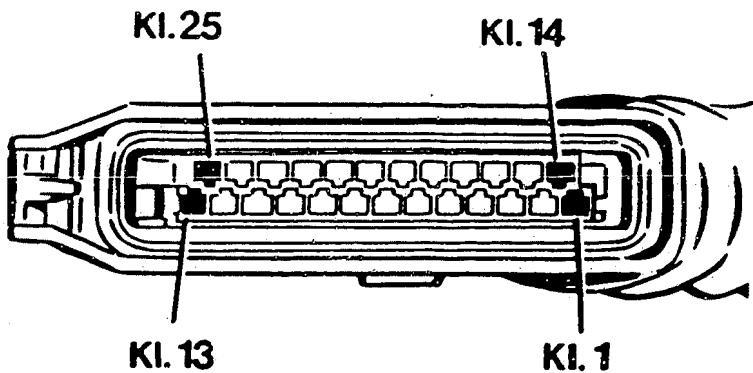
Test step	Testing of component/function Test instructions/conditions	Termi- nals	Set values
10	EI CONTROL-UNIT FUNCTION Ignition-distributor, trigger-box and EI control-unit plugs attached. Connect oscilloscope "Special" consecutively to trigger-box plug and vehicle ground. See top picture. Actuate starting motor.	5 B- 6 B- (+) (-)	Rectangular pulse (center picture)
11	CONTACT RESISTANCE (primary side) Detach negative and positive lead of battery. Trigger-box plug is detached. Ignition ON. Resistance between battery terminal and trigger-box plug. Resistance between battery terminal and ignition coil. Resistance between ignition coil and trigger-box plug.	B+ 4 B- 2 B+ 15 1 1	Max. 0.3 Ω Max. 0.3 Ω
12	PRIMARY SIGNAL Attach trigger-box plug. Oscilloscope/engine-speed tester to ignition coil. Actuate starting motor.	15 1 (+) (-)	Primary voltage/ engine-speed reading (magnitude irrelev.)
13	MICROSWITCH (IDLE CONTACT) Ignition off. Detach EI control-unit plug. Resistance between EI control-unit plug and vehicle ground (bottom picture). Throttle valve closed. Open throttle valve approx. 2°.	7 B-	Approx. 0 Ω Infinity Ω



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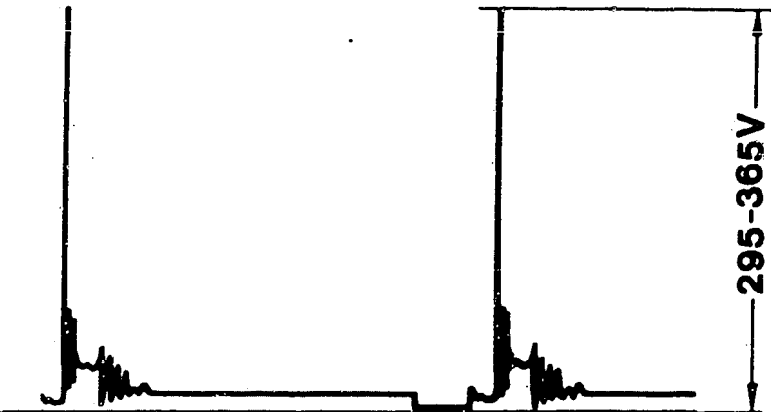
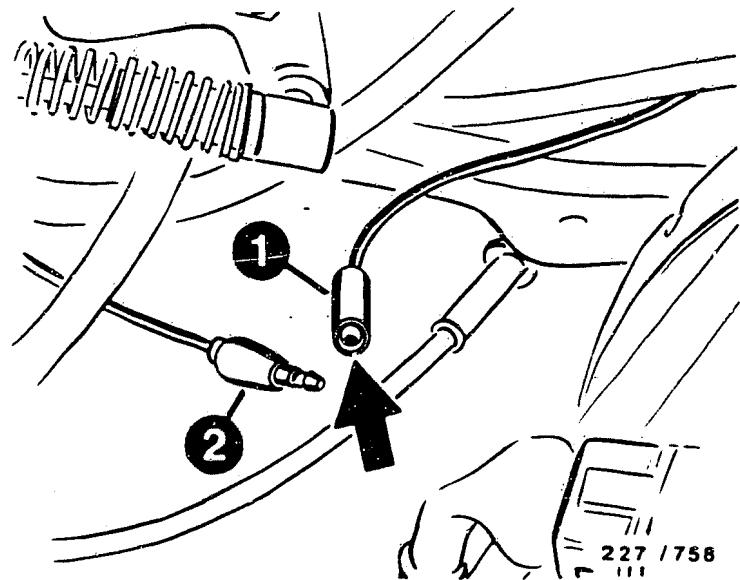
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RAPID DIAGNOSIS CHART (CONTINUED)

Test step	Testing of component/function Test instructions/conditions	Termi- nals	Set values
14	BASIC IGNITION SETTING Throttle valve (idle contact) closed. Vacuum hose, EI control unit attached. Engine at operating temperature. Engine idling ($900 \pm 25 \text{ min}^{-1}$)		$12 \pm 1^\circ \text{ BTDC}$
15	SOLENOID VALVE (IDLE COMPENSATION) Detach plug connection from solenoid valve. Run engine at idle and apply electrical loads (lights, rear window heater etc.). Note down idle speed. Connect solenoid-valve plug to battery positive See top picture, item 2 Note down idle speed.		Slight increase in engine speed.
16	VOLTAGE, IGNITION COIL Voltage, ignition coil and battery. Engine idling.	15 B- (+) (-)	Equal to/greater than 10 V
17	PRIMARY VOLTAGE Oscilloscope with pulse-shaping circuit to ignition coil. Engine idling See bottom picture.	15 1 (+) (-)	295...365 V



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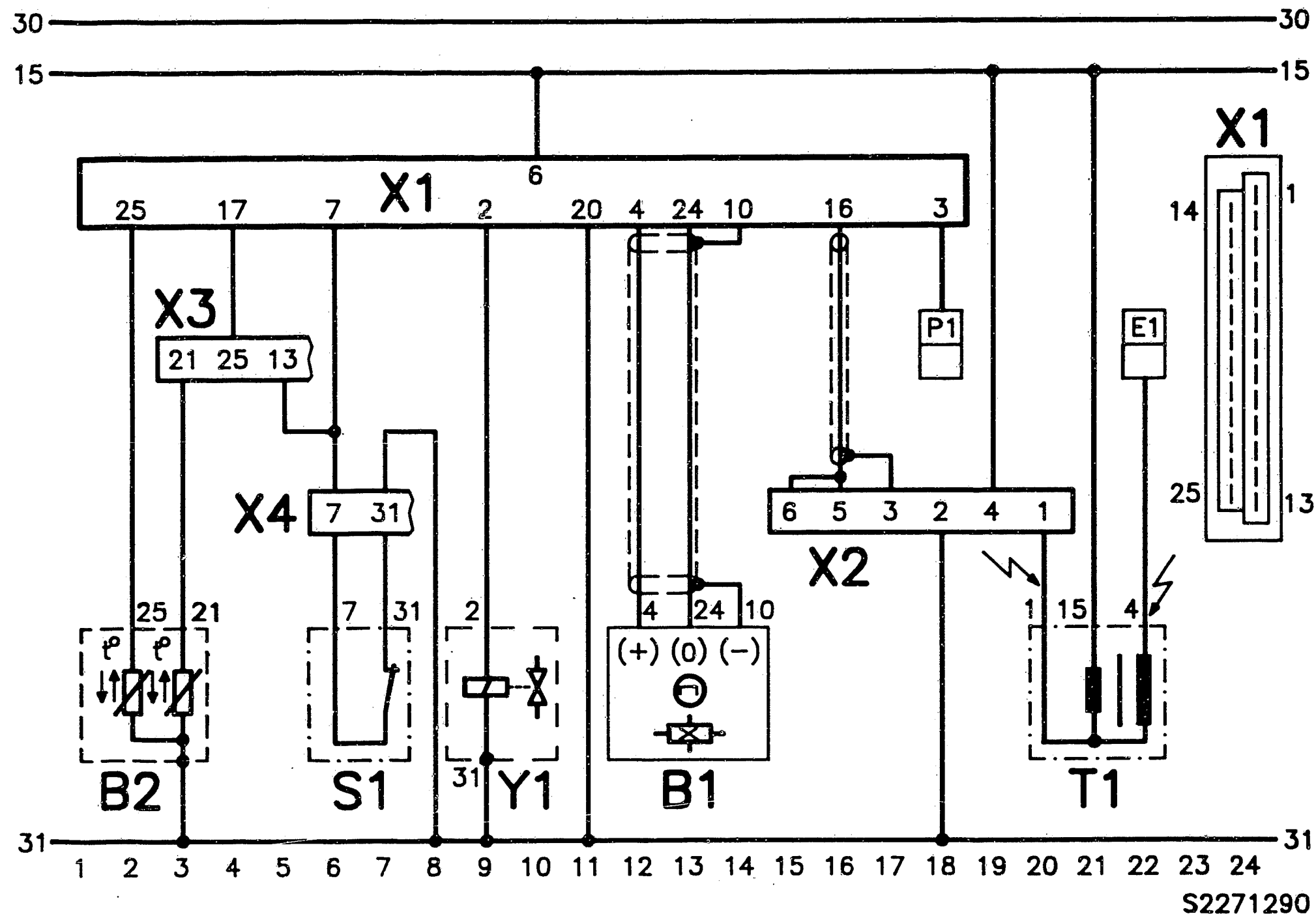
TEST SPECIFICATIONS

Ignition coil, primary	0,6... 1,1 Ω
Ignition coil, secondary	6,4...11,1 k Ω
Voltage, EI control unit with ignition ON.	Battery voltage
Voltage, trigger box with ignition ON	Battery voltage
Voltage, primary circuit with ignition ON	Battery voltage
Magnetic pulse generator, voltage supply with ignition ON	Equal to/greater than 10 V
Magnetic-pulse-generator function at cranking speed	Rectangular pulse
EI control-unit function at cranking speed	Rectangular pulse
Contact resistance Supply leads Trigger box or primary circuit	Max. 0,3 Ω
Primary signal at cranking speed	Primary voltage / engine-speed reading
Temperature sensor (coolant)	
+ 20° C	2,1...3,0 k Ω
+ 30° C	1,4...2,0 k Ω
+ 80° C	280...380 Ω
+ 90° C	210...280 Ω
+100° C	160...220 Ω

TEST SPECIFICATIONS (CONTINUED)

Basic ignition setting with engine idling (observe adjustment conditions).	12 \pm 1° BTDC 900 \pm 25 min ⁻¹
Solenoid valve (idle compensation)	24...40 Ω
Engine idling Idle compensation	900 \pm 25 min ⁻¹ 750...950 min ⁻¹
Voltage, ignition coil with engine idling	Equal to/greater than 10 V
Primary voltage with engine idling	295...365 V

Refer to Autodata test specifications for settings as regards idle speed, exhaust gas, valve clearance etc.



ELECTRICAL TERMINAL DIAGRAM

High-tension arrows: caution 400 V...25 kV

B1 = Magnetic pulse generator (ignition distributor)

B2 = Temperature sensor (coolant, twin NTC)

E1 = to ignition distributor

P1 = Diagnosis connection

S1 = Microswitch (idle contact)

T1 = Ignition coil

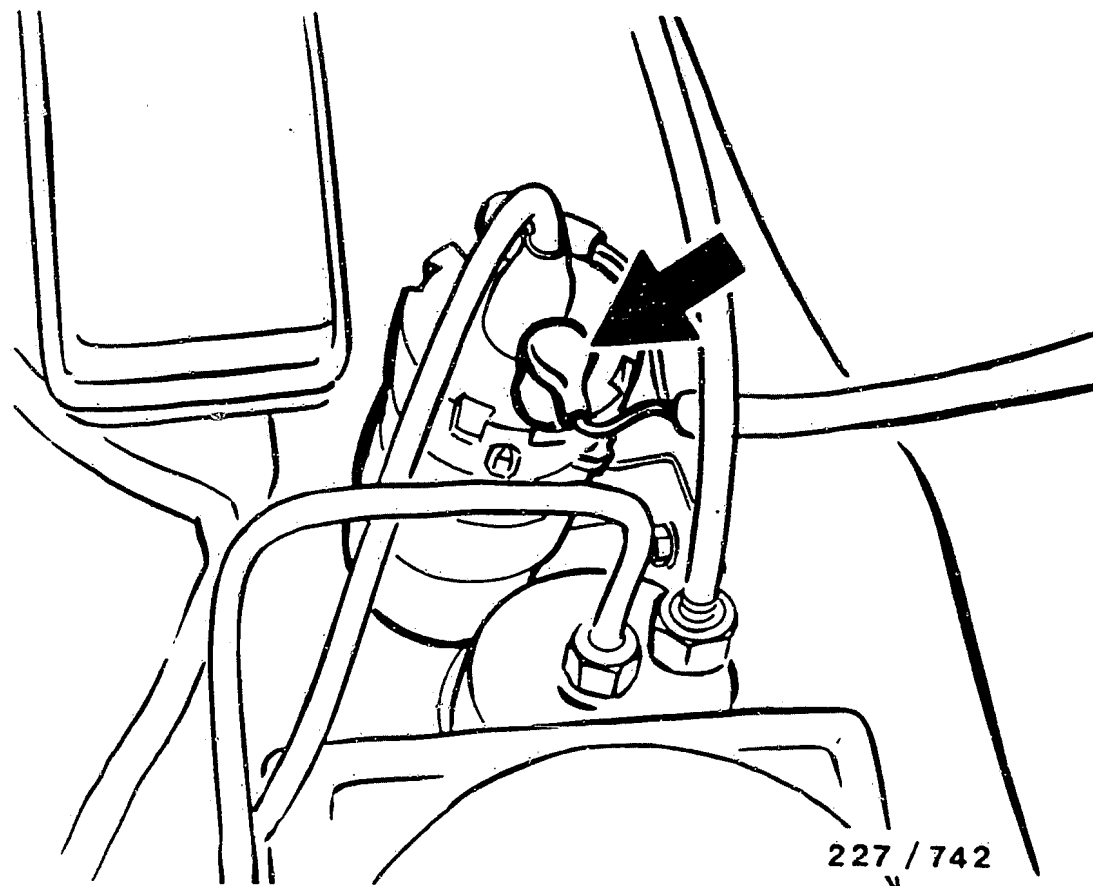
X1 = EI control-unit plug

X2 = Trigger-box plug

X3 = Control-unit plug, KE-Jetronic

X4 = Plug, idle/full-load contact

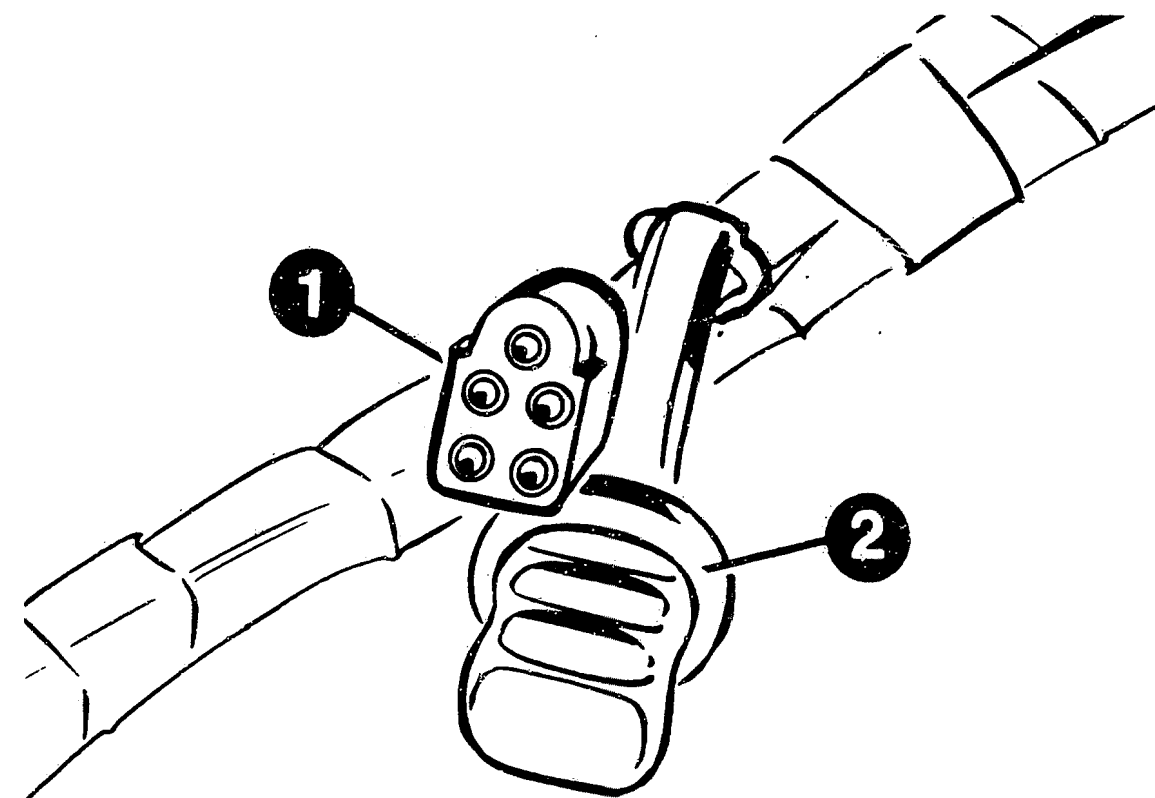
Y1 = Solenoid valve (idle compensation)



Arrow = ignition coil with trigger box

INSTALLATION POSITION OF COMPONENTS

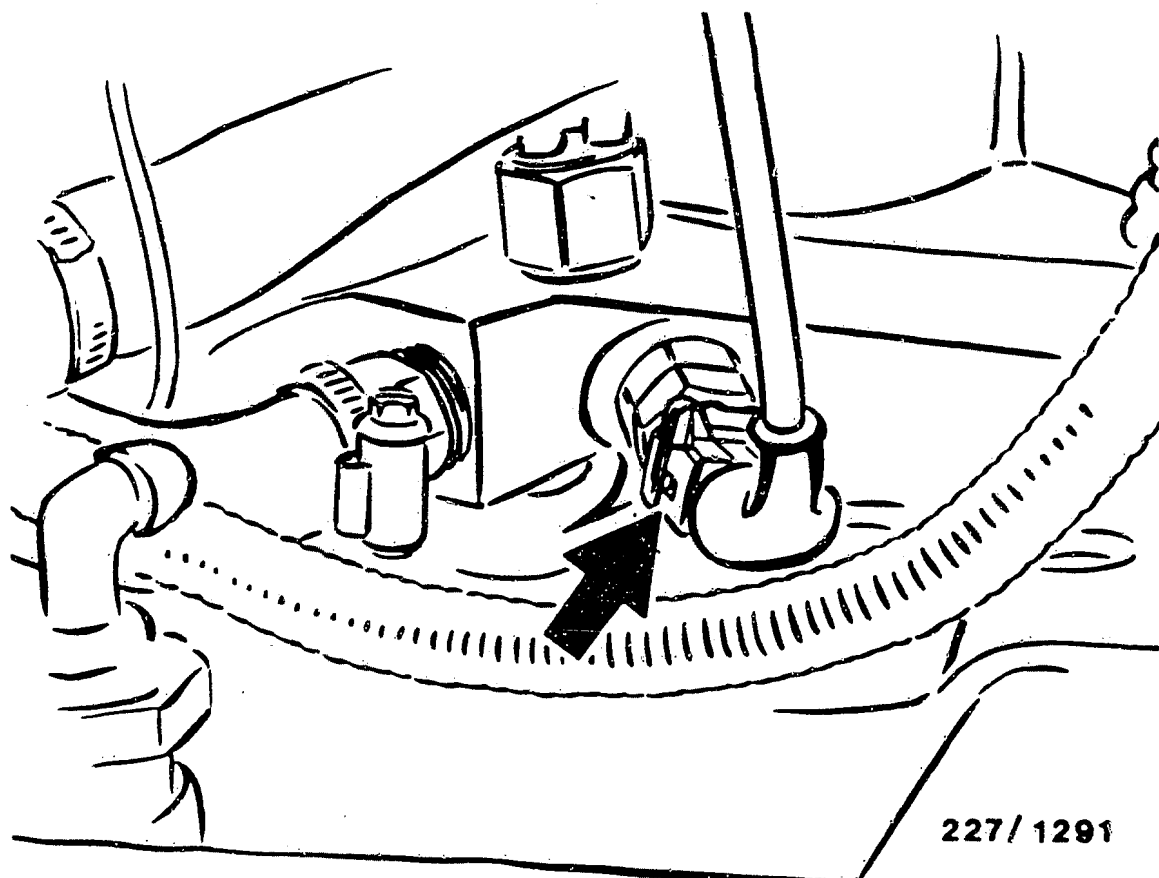
The trigger box and ignition coil are located on a heat sink in the engine compartment, left in the vicinity of the master brake cylinder.



1 = Diagnosis connection
2 = Cover plate

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

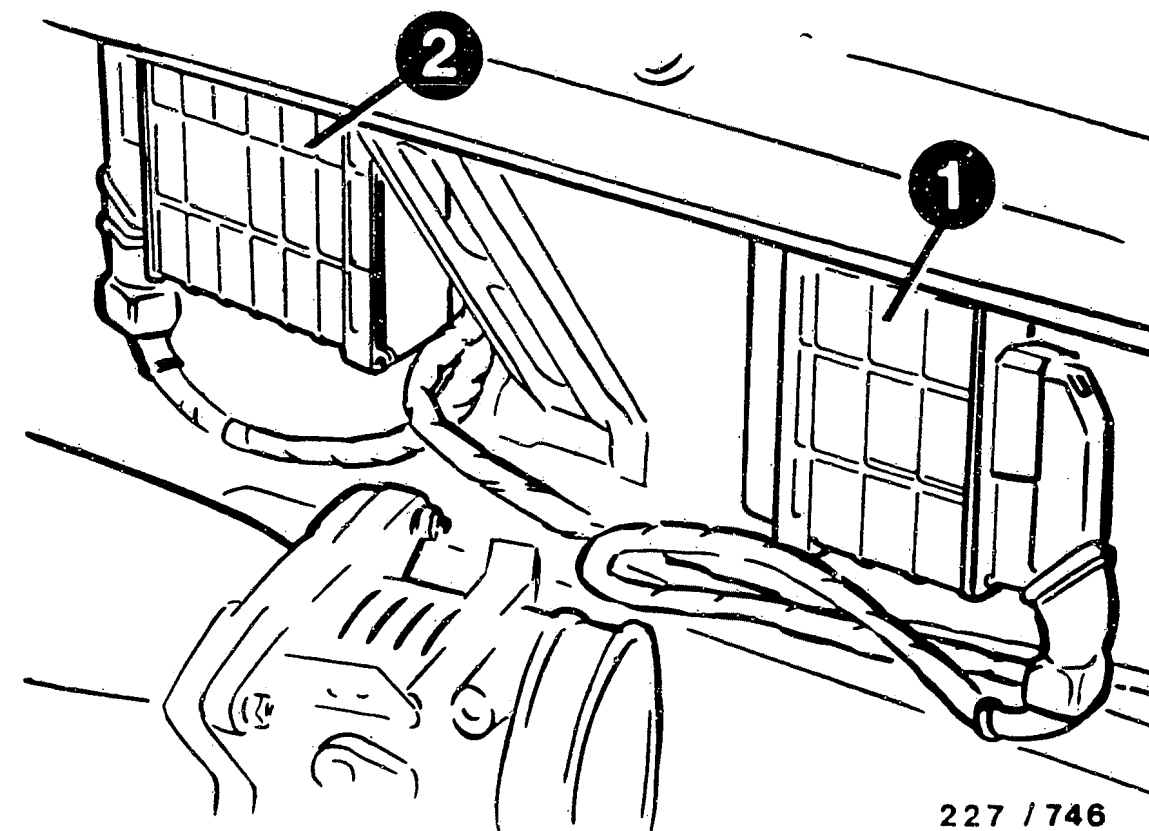
The diagnosis connection is located at the wiring harness (wheel house, left).



Arrow = Temperature sensor (coolant)

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

The temperature sensor (coolant) is located at the cylinder head beneath the intake manifold.



1 = EI control unit
2 = KE-Jetronic control unit

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

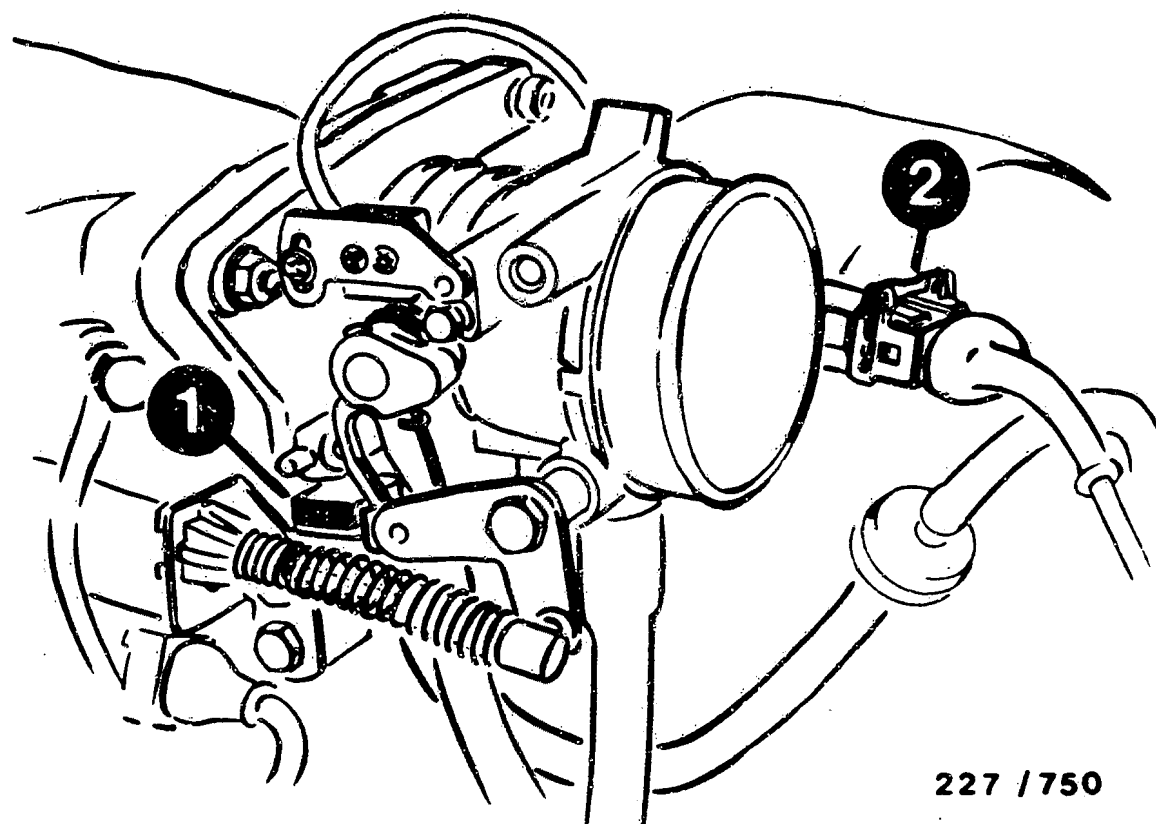
The EI control unit is located in the engine compartment behind the heating blower.

Removal instructions:

Remove rubber surround (not illustrated) from heating-blower shaft and loosen clamps.

Remove front section of blower shaft.

Unscrew both nuts of heating blower and remove heating-blower assembly.

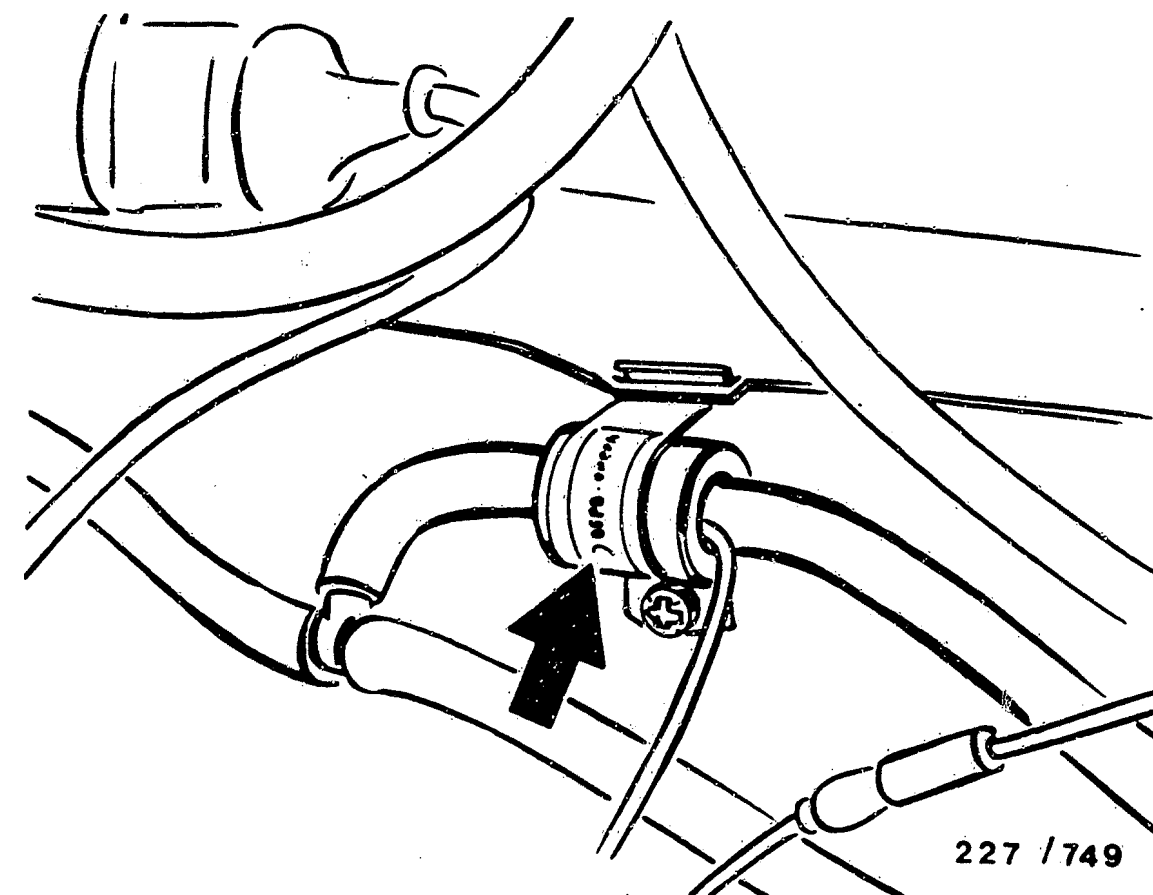


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- 1 = Microswitch (idle contact)
- 2 = Plug connection (idle/full-load contact)

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

The microswitch (idle contact) is located at the throttle-valve assembly.



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Arrow = Solenoid valve (idle compensation)

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

The solenoid valve is located at the engine bulkhead (oil-filter level).

Trouble-shooting instructions : POR-5015

BOSCH system : Tire check sys. (RKS)
RKS-G

Make of vehicle : PORSCHE

Basic microcard : PKW-132

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SPECIAL FEATURES

These trouble-shooting instructions, valid at the time of publication, apply to the following vehicle models:

* PORSCHE 928 08.88->

RKS-G system with self-diagnosis and 35-pole control-unit plug.

* The fault memory can be read out with an ON-BOARD diagnosis unit.
With ON-BOARD DIAGNOSIS the Porsche designation RDK appears instead of the designation RKS-G.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

Identical test-step numbering makes it easier to find individual test steps in brief and basic instructions.

SAFETY AND PRECAUTIONARY MEASURES

- * The entire RKS-G must be tested after replacing the pressure switch, control unit (evaluation electronics), HF sensor and wiring harness as well as after performing work affecting the tire check system (e.g. wheel change or accident repair work).
- * Non-workmanlike replacement of the pressure switch can be fatal.

TROUBLE-SHOOTING CHART

Customer complaint (fault symptoms)

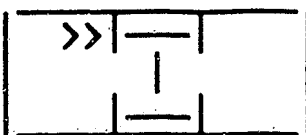

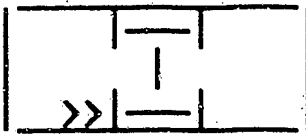
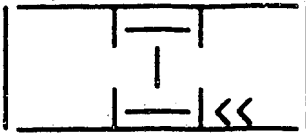





1. RDK DEACTIVATED appears on display
2. At speeds less than 50 km/h TIRE PRESSURE appears on display with arrow pointing to arbitrary wheel
3. At speeds in excess of 50 km/h TIRE PRESSURE LOSS appears on display with flashing arrow at arbitrary wheel
4. RDK DEACTIVATED appears sporadically.
5. Warning lamp (indicator lamp) lights up all the time
6. Warning lamp lights up sporadically.

						Cause (component fault)
X	X	X	X	X	X	Self-diagnosis
X				X		Control unit defective
X				X		Wheel-speed sensor 1)
X		X		X		High-frequency sensor 1)
X		X		X		Pressure switch 1)
X				X	X	Interface, instrument cluster
X				X		Warning lamp defective 1)
	X	X				Tire pressure too low
X	X	X	X	X	X	Read fault memory

1) Components are tested with actual-value list.

HOW TO USE SELF-DIAGNOSIS TEST TABLE FOR ON-BOARD DIAGNOSIS

Version RR 00

Fault indication on instrument cluster			Test instructions/test conditions	
TIRE		PRESSURE	FL arrow lights up all the time	A wheel arrow lights up all the time if a pressure switch indicates a tire pressure loss. Increase tire pressure by approx. 200 mbar. Increase pressure at other tire on same axle to same value. The display must go out following brief check drive (at least 20 m) at > 5 km/h.
TIRE		PRESSURE	FR arrow lights up all the time	
TIRE		PRESSURE	RL arrow lights up all the time	
TIRE		PRESSURE	RR arrow lights up all the time	
TIRE		PRESSURE LOSS	FL arrow flashes	If arrow flashes, proceed in exactly the same manner as when arrow lights up constantly. Repeat process until alarm is no longer given. A tire pressure of max. 3.5 bar at the front axle and 4.0 bar at the rear axle must not be exceeded. If the display does not go out, release air at both pressure switches until display RDK DEACTIVATED appears.
TIRE		PRESSURE LOSS	FR arrow flashes	
TIRE		PRESSURE LOSS	RL arrow flashes	
TIRE		PRESSURE LOSS	RR arrow flashes	
RDK		DEACTIVATED	Read and evaluate fault memory	

SELF-DIAGNOSIS TEST TABLE FOR ON-BOARD DIAGNOSIS
Version R00

Fault ind. on instr. cluster			Test instructions/Test conditions	Terminals	Set values
Fault code	Fault location	Distinction			
01/104 01/ 40 01/ 98 01/ 34 01/100 01/ 36	HF sensor RL " " " " "	sporadic current sporadic current sporadic current sporadic current	Plausibility (level error) Plausibility (level error) Use ohmmeter to check lead from CU plug term. 34 to vehicle ground term. 13 for short to ground. Use ohmmeter to check for open circuit in lead from CU plug term. 34 to HF sensor.	34...13	0,88...0,94 0,64...0,76 > 100 k Ω approx. 0 Ω
02/104 02/ 40 02/ 98 02/ 34 02/100 02/ 36	HF sensor RR " " " " "	sporadic current sporadic current sporadic current sporadic current	Plausibility (level error) Plausibility (level error) Use ohmmeter to check lead from CU plug term. 17 to vehicle ground term. 13 for short to ground. Use ohmmeter to check lead from CU plug term. 17 to HF-sensor for open circuit.	17...13	0,88...0,94 0,64...0,76 > 100 k Ω approx. 0 Ω
03/104 03/ 40 03/ 98 03/ 34 03/100 03/ 36	HF sensor FL " " " " "	sporadic current sporadic current sporadic current sporadic current	Plausibility (level error) Plausibility (level error) Use ohmmeter to check lead from CU plug term. 35 to vehicle ground term. 13 for short to ground. Use ohmmeter to check lead from CU plug term. 35 to HF-sensor for open circuit.	35...13	0,88...0,94 0,64...0,76 > 100 k Ω approx. 0 Ω
04/104 04/ 40 04/ 98 04/34 04/100 04/ 36	HF sensor FR " " " " "	sporadic current sporadic current sporadic current sporadic current	Plausibility (level error) Plausibility (level error) Use ohmmeter to check lead from CU plug term. 18 to vehicle ground term. 13 for short to ground. Use ohmmeter to check lead from CU plug term. 18 to HF-sensor for open circuit.	18...13	0,88...0,94 0,64...0,76 > 100 k Ω approx. 0 Ω

SELF-DIAGNOSIS TEST TABLE FOR ON-BOARD DIAGNOSIS (CONTINUED)
Version R00

Fault ind. on instr. cluster			Test instructions/Test conditions	Terminals	Set values
Fault code	Fault location	Distinction			
05/104	Wheel-speed sensor RL	sporadic current	Air gap between wheel-speed sensor RL and ring gear too large. Ring gear defective, loose or wrong number of teeth. Check leads of wheel-speed sensors from RKS-G control unit term. 26 to ABS controller term. 30 for open circuit.	RKS-G/ABS	45 teeth
05/ 40	"	sporadic current		26...30	approx. 0 Ω
05/100	"	current			
05/ 36					
06/104	Wheel-speed sensor RR	sporadic current	Air gap between wheel-speed sensor RR and ring gear too large. Ring gear defective, loose or wrong number of teeth. Check leads of wheel-speed sensors from RKS-G control unit term. 8 to ABS controller term. 31 for open circuit.	RKS-G/ABS	45 teeth
06/ 40	"	sporadic current		8...31	0 Ω
06/100	"	current			
06/ 36					
07/104	Wheel-speed sensor FL	sporadic current	Air gap between wheel-speed sensor FL and ring gear too large. Ring gear defective, loose or wrong number of teeth Check leads of wheel-speed sensors from RKS-G control unit term. 29 to ABS controller term. 17 for open circuit.	RKS-G/ABS	45 teeth
07/ 40	"	sporadic current		29...17	approx. 0 Ω
07/100	"	current			
07/ 36					
08/104	Wheel-speed sensor FR	sporadic current	Air gap between wheel-speed sensor FR and ring gear too large. Ring gear defective, loose or wrong number of teeth. Check leads of wheel-speed sensors from RKS-G control unit term. 28 to ABS controller term. 23 for open circuit.	RKS-G/ABS	45 teeth
08/ 40	"	sporadic current		28...23	aprox. 0 Ω
08/100	"	current			
08/ 36					
09/ 97	Warning lamp in instrument cluster (indicator lamp)	sporadic current	Replace warning lamp, lamp does not light up following "ignition on", remove lamp. Use voltmeter to take measurement with detached control unit at CU plug at term.3. Use ohmmeter to measure lead from CU plug term. 3 to indicator lamp for open circuit.	3...13	approx. 0 V
09/ 33		sporadic current			approx. 0 Ω
09/100		current			
09/ 36					

SELF-DIAGNOSIS TEST TABLE FOR ON-BOARD DIAGNOSIS (CONTINUED)
Version R00

Fault ind. on instr. cluster			Test instructions/Test conditions	Term- inals	Set values
Fault code	Fault location	Distinc- tion			
17/ 00	Control unit	———	Not yet functional	———	———
18/100 20	Serial interface	sporadic current	Use voltmeter to measure instrument cluster voltage at CU plug term. 19...13 and term. 18/ 36. Caution: Initiation of stimulation may also cause the fault 18 to be stored in the fault memory.	RKS-G/DIAG 19 20...13	approx. U Batt. approx. U Batt.
19/ 00	Battery	———	$U_B < 8\text{ V}$	33...13	approx. U Batt.

Fault indication on instrument cluster	Test instructions/Test conditions	Term- inals	Set values
CLEAR MEMORY R00	If yes, press steering-column lever down for 3 seconds. If no, move steering-column lever upwards.	———	———
ACTUATE ACTUATORS R00 ?	No function/pull steering-column lever to effect switching to sensor display.	———	———

SELF-DIAGNOSIS TEST TABLE FOR ON-BOARD DIAGNOSIS (ACTUAL-VALUE LIST)
Version R 00

Fault ind. on instr. cluster (Actual values)	Test instructions/Test conditions		Term- inals	Set values
TEST SENSORS R 00 ?	If yes, pull steering-column lever. If no, move steering-column lever upwards.			
SENSOR 01 R 00	Note down values	Divide value read off from sensor 01 by value read off from sensor 10		88...94 % 64...74 %
SENSOR 02 R 00	Note down values	Divide value read off from sensor 02 by value read off from sensor 10		88...94 % 64...74 %
SENSOR 03 R 00	Note down values	Divide value read off from sensor 03 by value read off from sensor 10		88...94 % 64...74 %
SENSOR 04 R 00	Note down values	Divide value read off from sensor 04 by value read off from sensor 10		88...94 % 64...74 %

SELF-DIAGNOSIS TEST TABLE FOR ON-BOARD DIAGNOSIS (ACTUAL-VALUE LIST CONTINUED)
Version R 00

Fault ind. on instr. cluster	Test instructions/Test conditions	Terminals	Set values
SENSOR 05 R 00	Vehicle at a standstill Move vehicle at 10 km/h		00 07-09
SENSOR 06 R 00	Vehicle at a standstill Move vehicle at 10 km/h		00 07-09
SENSOR 07 R 00	Vehicle at a standstill Move vehicle at 10 km/h		00 07-09
SENSOR 08 R 00	Vehicle at a standstill Move vehicle at 10 km/h		00 07-09
SENSOR 09 R 00	A decimal value appears on the display (no significance)	—	—
SENSOR 10 R 00	A decimal value appears on the display Required for sensor testing 01 ... 04.		91...181
SENSOR 11 R 00	Indicator lamp lights up Indicator lamp off		0... 3 250...255
SENSOR 12 R 00	A decimal value appears on the display (no significance)	—	—

SELF-DIAGNOSIS TEST TABLE FOR ON-BOARD DIAGNOSIS (ACTUAL-VALUE LIST CONTINUED)
Version R 00

Fault ind. on instr. cluster	Test instructions/Test conditions	Term- inals	Set values
TEST SWITCH 00 R ?	If yes, pull steering-column lever. If no, move steering-column lever upwards.		
SWITCH 01 R 00	Turn corresponding wheel until one of the two pressure switches in the rim is over the high-frequency sensor. If CLOSED appears, position other pressure switch in rim over high-frequency sensor. If pressure switch is over high-frequency sensor and CLOSED does not appear, check tire pressure. In the event of correct tire pressure, replace the pressure switch concerned.		OPEN CLOSED
SWITCH 02 R 00			OPEN CLOSED
SWITCH 03 R 00			OPEN CLOSED
Switch 04 R 00			OPEN CLOSED
PERFORM SF R 00 ?	Not assigned		

A test drive is to be performed after reading out the fault memory and clearing the faults.

TEST SPECIFICATIONS

Tightening torque for pressure sensor 20 Nm

Tightening torque for HF-sensor
fastening screws 4,1...5,5 Nm

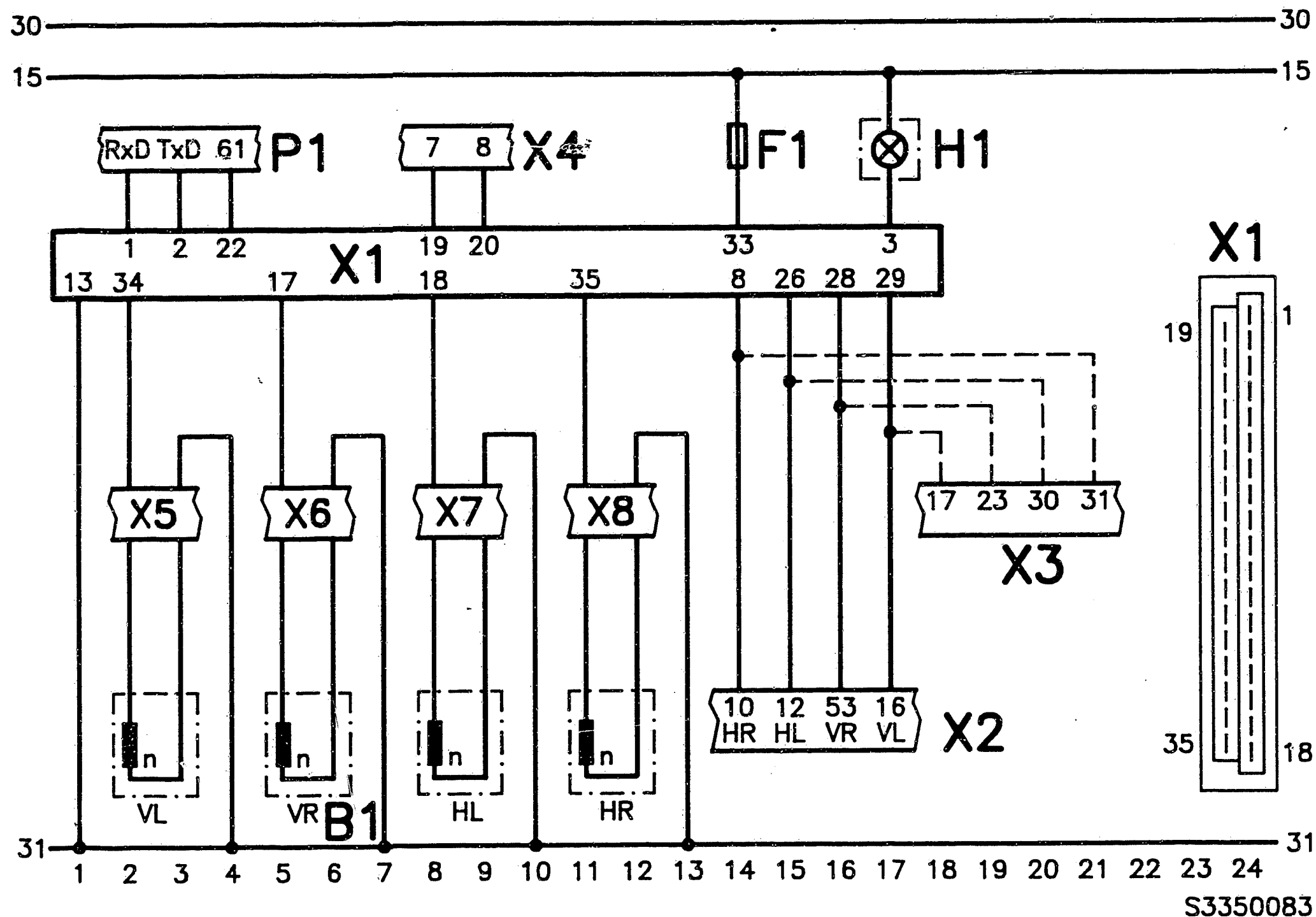
Tire pressure, front axle at 20°C 2,5 bar
rear axle at 20°C 3,0 bar

HF-sensor resistance value 4,75...5,25 k Ω

Wheel-speed sensor 600...1600 Ω

HF-sensor current consumption attenuated 15...20 mA
non-attenuated 2...3 mA

For production reasons:
continued on the following
coordinate.



ELECTRICAL TERMINAL DIAGRAM

B1 = High-frequency sensor
H1 = RKS-G warning lamp
P1 = Instrument cluster

X1 = Control-unit plug RKS-G (35-pole)
X2 = Control-unit plug ABS (55-pole)
X3 = Control-unit plug ABS (35-pole)
X4 = Diagnosis socket
X5-X8 = Multiple butt connectors, high-frequency sensor

FL = Front left
FR = Front right
RL = Rear left
RR = Rear right

INSTALLATION POSITION OF COMPONENTS

Removal and installation instructions

Front axle: (top picture)

Rear axle: similar

Pressure-switch removal:

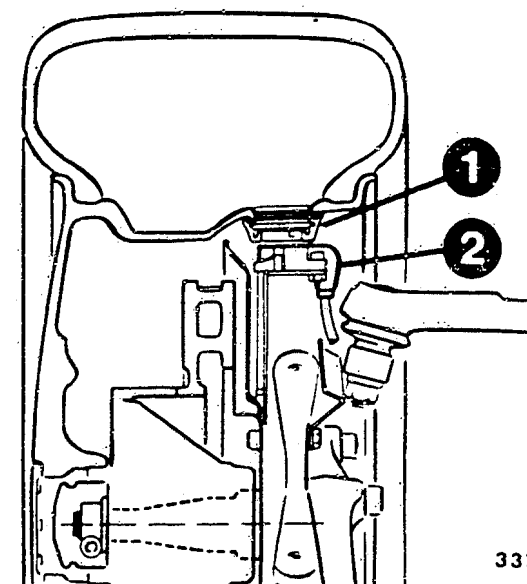
- * Remove tire and then remove deflector (arrow, bottom picture) over pressure switch.
Caution: When removing tire, do not position pressing-off device of tire-mounting device in area of pressure switches (press off with 90° offset).
- * Disassemble pressure switch using customer service tools KDES 0013 and KDES 0014.

The following is to be noted when installing a pressure switch:

- * Grease O-ring with vaseline.
- * O-ring is not to be pulled over sharp edges (threads, grooves, corners etc.). Only the mounting sleeve KDES 0015 is to be used for attaching the O-ring to the pressure switch. The O-ring must not be positioned in the mounting groove such that it is wrongly twisted.
- * Insert pressure switch in rim on correct side (see top picture).
Attach pin-type socket wrench KDES 0013 to pressure switch and hold it in position. Tighten fastening nut of pressure switch with socket wrench KDES 0014. Tightening torque 20...25 Nm.

HF - sensor disassembly:

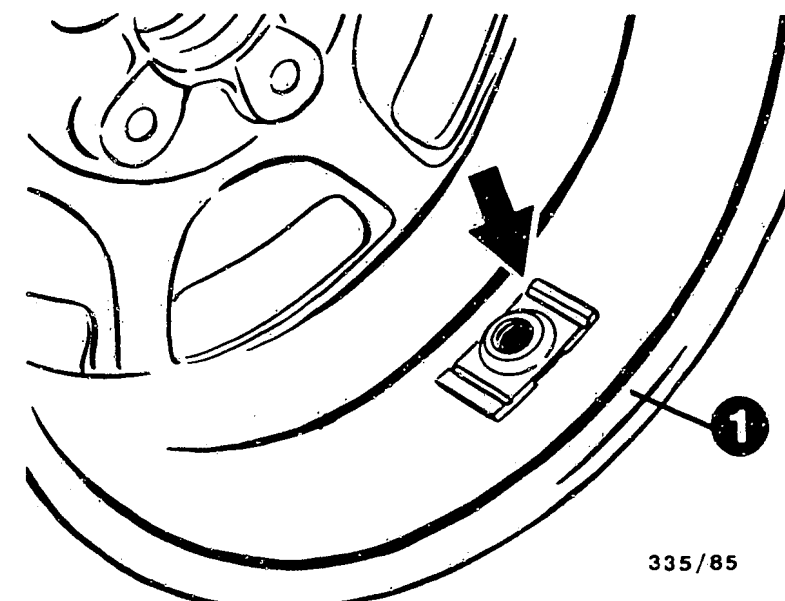
- * Loosen and remove two fastening screws.
- * Release triple plug connection and pull out HF sensor plug.
- * Install new HF-sensor in reverse order.



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1 = Pressure switch
2 = HF sensor

Arrow = Deflector
1 = Rim

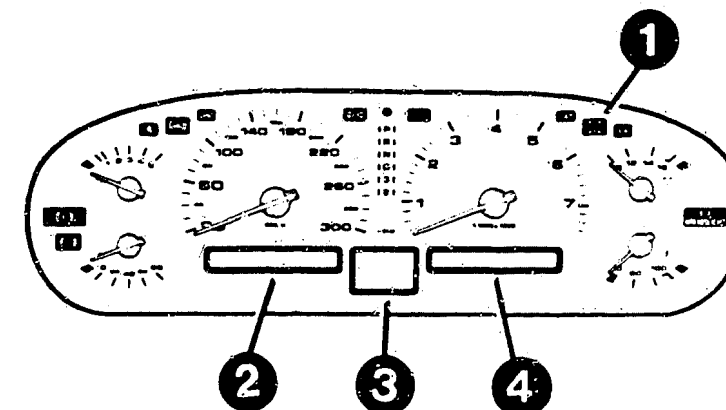


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INSTALLATION POSITION OF COMPONENTS (CONTINUED)

Instrument cluster: top picture

- 1 = RKS-G warning lamp
- 2 = Left-hand display panel
- 3 = Center display panel (Pictogram)
- 4 = Right-hand display panel

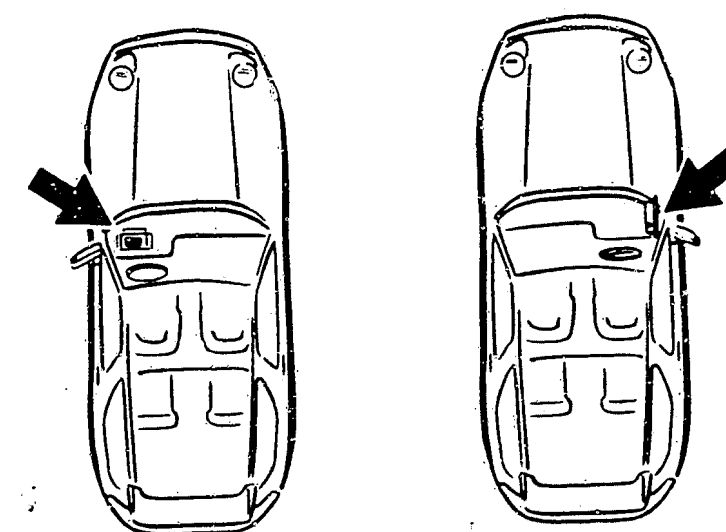


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Control unit: Center picture

On LHD vehicles in driver's footwell at lower section of instrument panel, left.

On RHD vehicles in driver's footwell at right-hand side wall.

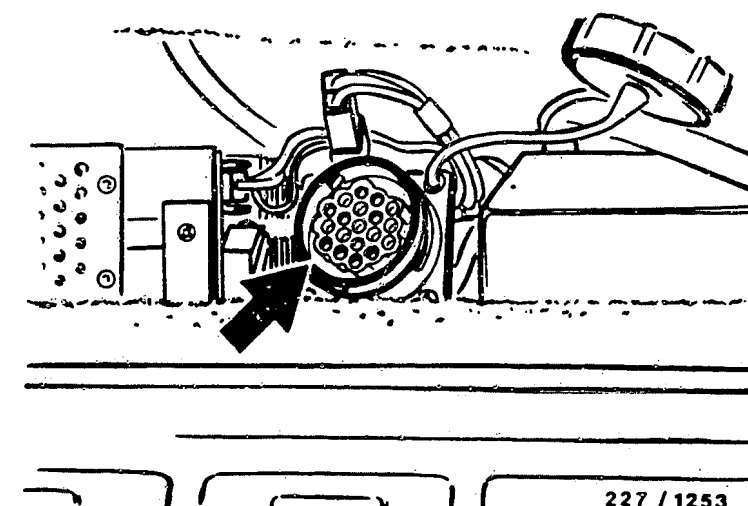


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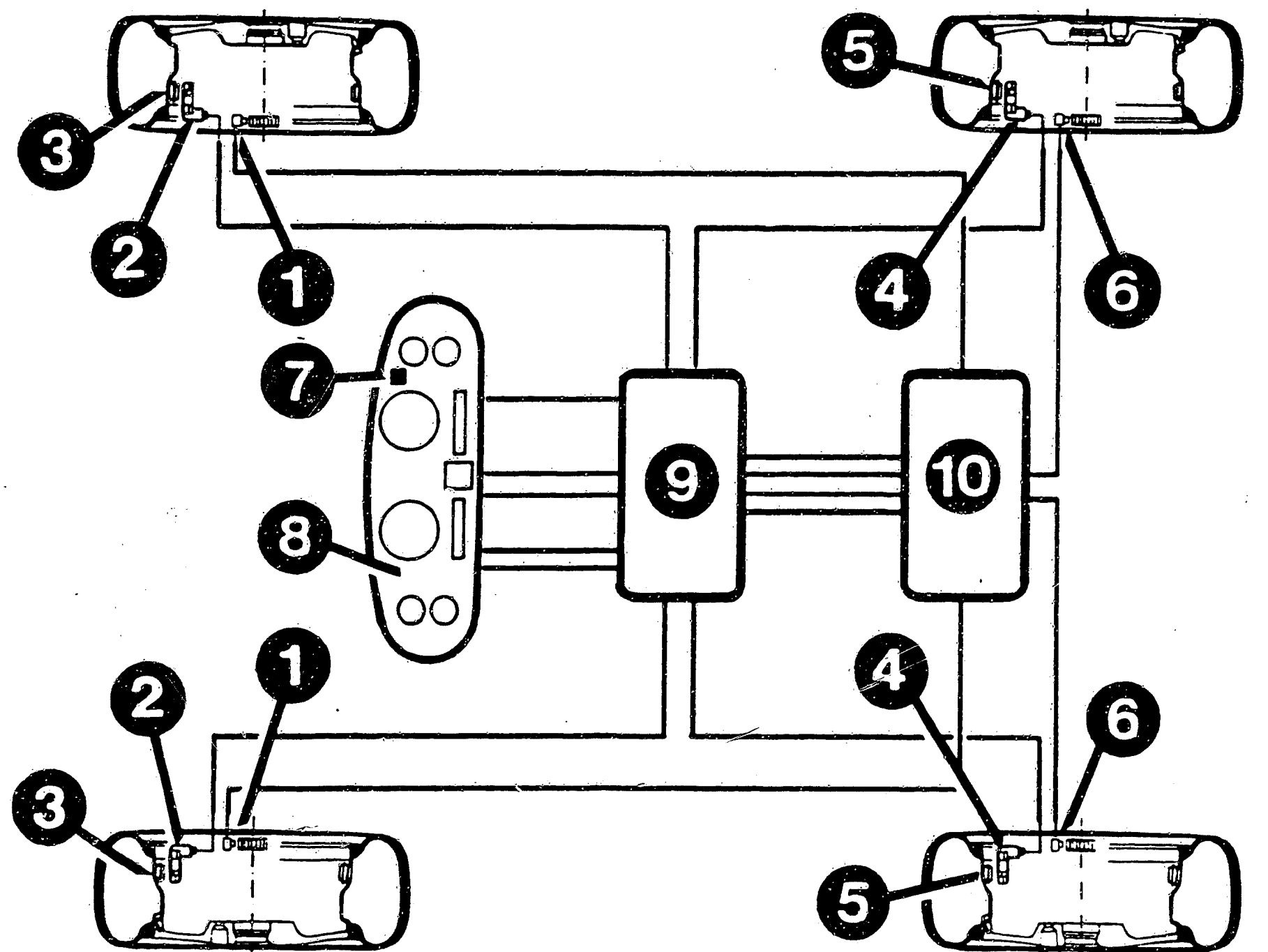
Diagnosis socket: bottom picture

On right next to passenger's seat beneath a cover.

Cover is secured with two knurled screws which can be unscrewed by hand.



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INSTALLATION POSITION OF COMPONENTS (CONTINUED)

- 1 = Wheel-speed sensor, front axle
- 2 = High-frequency sensor, front axle
- 3 = Pressure switch, front axle
- 4 = High-frequency sensor, rear axle
- 5 = Pressure switch, rear axle

- 6 = Wheel-speed sensor, rear axle
- 7 = Warning lamp
- 8 = Instrument cluster
- 9 = RKS-G control unit
- 10 = ABS controller

Trouble-shooting instructions : OPE-5020

BOSCH system : Motronic ML 4.1

Make of vehicle : OPEL

Basic microcard : PKW-050

TABLE OF CONTENTS

<u>Section</u>	<u>Coordinates</u>
Special features	02
Structure, usage, safety and precautionary measures	06
Trouble-shooting chart	07
Self-diagnosis test table	09
Test specifications	15
Electrical terminal diagram	19
Installation position of components, notes on removal and installation	23

SPECIAL FEATURES

These trouble-shooting instructions, valid at the time of publication, apply to the following vehicle models:

* OPEL Vectra (9.88 ->),
Vectra 4X4 (2.89 ->)
with and without catalytic converter,
Engine: 2.0 l / 4-cylinder,
Engine type OHC, C 20 NE, C 20 NEF,
20 NE, 20 SEH

* Motronic ML 4.1 with self-diagnosis and
35-pole control-unit plug.

* The fault memory can be read out using the Pocket
System Tester KTS 300 (0 684 400 300) with the
program module PPG 204 as of status 09.01.89.

Note:

Further diagnosis possibilities (actuator diagnosis
etc), which would be feasible with newer program-module
statuses, are not evaluated with these vehicles.

Pay attention to operating instructions for KTS 300.
Connection of the KTS 300 to the diagnosis socket in
the vehicle is via the adapter lead 1 684 465 187
(Opel).

* As an alternative to the KTS 300, the self-diagnosis
can be read out by way of a flashing code (not possible
with all control units).

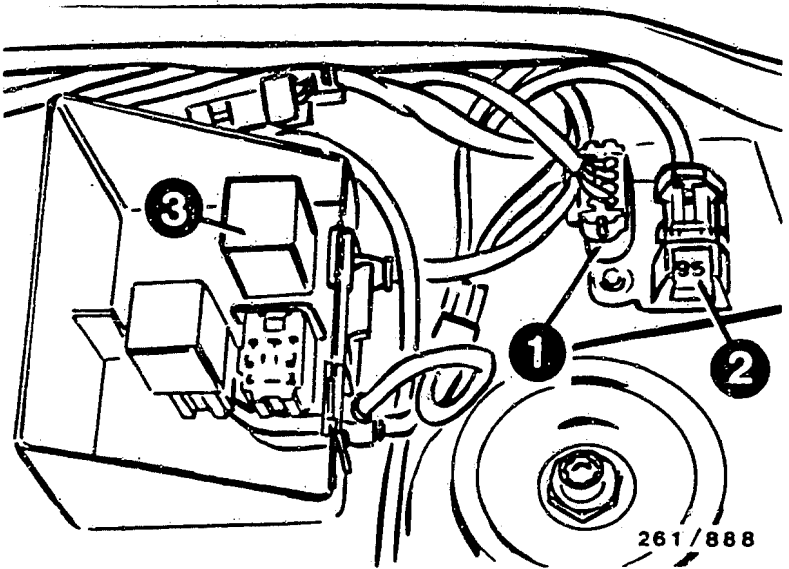
* One joint sensor for engine speed and
reference mark

* Single-winding rotary actuator

* Variant encoding for octane-number adjustment
and transmission

Variant encoding

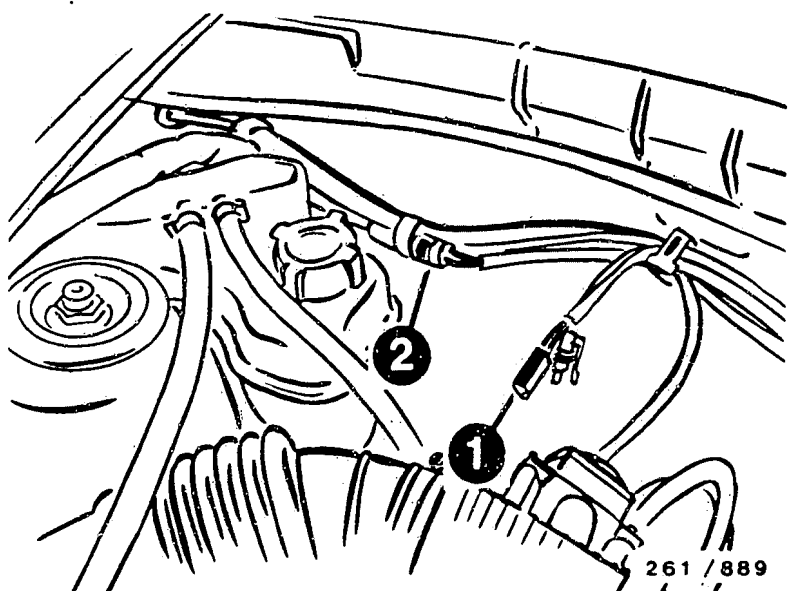
Octane number	Resistance at term. 15		
	2 l engine, low compression (9.2) without catalytic converter (fact. encoding 98 RON)	2 l engine, high compression (10), w/o catalytic converter (fact. encoding 95 RON)	2 l engine, high compression (10), w/o catalytic converter (fact. encoding 98 RON)
91 RON	0 Ω 1)	0 Ω 1)	—
	infinity Ω 2)	infinity Ω 2)	—
	—	750 Ω 2)3)5)	—
95 RON	220 Ω 1)	220 Ω 1)	220 Ω 1)
	1200 Ω 3)4)	1200 Ω 3)	1200 Ω 3)4)
	2200 Ω 2)	2200 Ω 2)	2200 Ω 2)
	4700 Ω 2)3)4)	4700 Ω 2)3)	4700 Ω 2)3)4)
	750 Ω 2)3)4)5)	—	infinity Ω 2)3)4)5)
98 RON	470 Ω 1)	—	470 Ω 1)
	—	—	750 Ω 2)



- 1 = Diagnosis plug
- 2 = Octane-number encoding plug (term. 15)
- 3 = Motronic relay

- 1 = Encoding plug for term. 27
- 2 = Plug-in connection for lambda sensor

91 RON = Regular gasoline, unleaded or leaded for vehicles without catalytic converter
95 RON = Premium unleaded gasoline
98 RON = Premium leaded gasoline
1) Basic value
2) Idle speed is increased by 100 min⁻¹.
3) Acceleration enrichment is enriched.
4) Mixture is enriched; Lambda +5% correspond to approx. 1% CO.
5) Ignition timing = -5.25 °CS (retarded) over entire map range.



Vehicles with catalytic converter:
term. 27 infinity Ω (open)
Vehicles without catalytic converter:
term. 27 zero Ω (to ground)
Vehicles with manually shifted transmission:
term. 10 infinity Ω (open)
term. 28 zero Ω (to ground)

Vehicles with automatic transmission:
term. 10 zero Ω (to ground)
term. 28 to selection-lever positions P and N: zero Ω (via selection lever to ground). In this way, idle speed is dropped in order to prevent driving off. In all other selection-lever positions, term. 28 is open (0 Ω)

* Adaptive lambda closed-loop control.

Note:

If engine won't start after replacing lambda sensor or injection valves or following elimination of leaks in exhaust etc., briefly detach Motronic control-unit plug with ignition switched off. The adaption values are thus cancelled. Attempt to start again.

On official vehicles (C20 NEF) the full-load function is deactivated and the power reduced. Lead to full-load contact interrupted. Note when testing. An orifice is additionally installed in the intake manifold.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults. For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!

High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

Avoid fuel injection and high-tension flashover when testing compression! Motronic relay is therefore to be disconnected.

TROUBLE-SHOOTING CHART

Customer complaint (symptoms of trouble)

1. Starting motor operates, but engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Rough idling (engine speed, exhaust gas).
4. Poor throttle response, flat spot during acceleration.
5. Engine misfiring (ignition, injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

Cause (component fault)										
*	*	*	*	*	*	*	*	*	*	Self-diagnosis
*										Voltage at control unit
*										Sensor
*		*		*	*					Fuel pressure
*		*			*	*				Solenoid-operated injection valves
		*	*							Idle contact
				*						Full-load contact
	*	*	*	*	*	*				Air-flow sensor
	*	*	*							Idle actuator
*	*	*	*							Air-induction system
		*								Idle speed
*		*		*	*					Ignition coil
*		*	*	*	*					Primary signal
		*	*	*	*	*				Secondary pattern
*	*	*	*		*	*		*	*	Ignition point
		*								Exhaust gas
		*								Overrun cut-off
		*	*	*						Interference-suppression resistors
		*	*	*						Noise test
				*						Interference

TROUBLE-SHOOTING CHART (CONTINUED)

Customer complaint (symptoms of trouble)

1. Starting motor operates but engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Rough idling (engine speed, exhaust gas).
4. Poor throttle response, flat spot during acceleration.
5. Engine misfiring (ignition, injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

Cause (component fault)										
				*					*	Throttle valve
				*						Fuel delivery
*	*	*								Air bleed of tank
	*	*								Lambda closed-loop control
*	*	*	*	*	*	*		*	*	Control unit

SELF-DIAGNOSIS TEST TABLE

Pocket System Tester Fault indication	Fault code	Flash- ing code	Test instructions / Test conditions	Term.	Set values
Data exchange not possible			Ignition on; Fault lamp lights up. Prerequisite for fault output: Leads to diagnosis plug/fault lamp and power supply to control unit including term. 18 O.K. Leads and power supply O.K., however no fault output: control unit defective.	4, 12, 17, 18	_____
Lambda sensor Open circuit	13	1 3	Open circuit in lead to lambda sensor. Sensor defective.	24	_____
Engine temp. sensor Short to ground	14	1 4	Test temperature sensor and lead for short to ground.	13	_____
Engine temp. sensor Op. circ./sh. to B+	15	1 5	Check temperature sensor and leads for open circuit (op. circ.) and short to positive (short to B+) Temperature-sensor resistance : at +15...+30°C : at approx. +80°C :	13, ground	1450...3300 Ω 280....360 Ω
Lambda sensor Short to ground	44	4 4	Check lead for short to ground. Watch out for worn insulation! Severe leaning, e.g. tank emptied. Leak in exhaust between engine and lambda sensor.	24	_____
Lambda sensor Short to B+	45	4 5	Check lead for short to positive (short to B+) Watch out for worn cable insulation! Mixture too rich.	24	_____
Battery voltage too low	48	4 8	Supply voltage for control unit too low (with engine running): Check voltage dips at positive and ground terminal. Charge battery. Check alternator system.	35(+), 5(-)	greater than 10 V
Battery voltage too high	49	4 9	Supply voltage for control unit too high (with engine running): Check alternator regulator.	35(+), 5(-)	less than 16 V

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket System Tester Fault indication	Fault code	Flash- ing code	Test instructions / Test conditions	Term.	Set values
Control unit Digital sec. (comput) defective	51 or 55	5 1 or 5 5	Control unit defective.	—	—
CO potentiometer Signal too low	65	6 5	Measure resistance of CO potentiometer (idle potentiometer) : Check lead for short to ground. Term. 3 open circuit. Term. 3 and term. 4 jumpered.	30	Measure resistance at air-flow sensor between term. 1 and term. 4: Minimum 0...30 Ω Maximum: The value measured between term. 3 and term. 4 may be up to 30 Ω less. (Set value between term. 3 and term. 4: 300...550 Ω)
CO potentiometer Signal too high	66	6 6	Measure resistance of CO potentiometer (idle potentiometer): Test potentiometer and leads for open circuit and short to positive. Fault code 7 4 is also indicated in the event of term. 4 open circuit.	30	
Idle switch Short to ground	67	6 7	Fault: Idle contact (in throttle-valve switch or sensor) permanently closed or lead short to ground. Idle contact closed in off position : Actuate throttle valve somewhat :	2, ground	approx. 0 Ω infinity Ω
Air-temp. sensor Short to ground	69	6 9	Check temperature sensor and lead for short to ground.	22	—
Air-temp. sensor Open circuit	71	7 1	Check temperature sensor and leads for open circuit. Temperature-sensor resistance : at +15°C...+30°C:	22, 6(-)	1450...3300 Ω
Full-load switch Short to ground	72	7 2	Fault: Full-load contact (in throttle-valve switch or sensor) permanently closed. Fault lamp only lights up intermittently during overrun. Full-load contact closed in full-throttle position : Release accelerator pedal somewhat :	3	approx. 0 Ω infinity Ω

1) Potentiometer has no effect on CO in vehicles with cat.

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket System Tester Fault indication	Fault code	Flash- ing code	Test instructions / Test conditions	Term.	Set values
Air-flow sensor/ Air-mass sensor Signal too low	73	7 3	Check: Lead to air-flow sensor term. 2 for short to ground, leads to term. 2 and term. 3 for open circuit, leads to term. 3 and term. 4 for mutual contact. Air-flow sensor defective.	6(-), 7, 9(+)	_____
Air-flow sensor/ Air-mass sensor Signal too high	74	7 4	Check: Lead to air-flow sensor term. 4 for open circuit (note: fault code 66 also appears), leads to term. 2 and term. 4 for short to positive (5V or B+). Check resistances of air-flow sensor : between term. 2 and term. 4 (deflect sensor flap): between term. 3 and term. 4: Air-flow sensor defective.	6(-), 7	8...2500 Ω 300...550 Ω
Transmission identification Short to ground	75	7 5	Check lead for short to ground. Transmission control unit (if fitted) faulty. Continue testing with electronic transmission control.	8	_____
No fault stored		1 2	Flashing code 1-2 is constantly repeated. Continue trouble-shooting with trouble-shooting chart.	—	_____

TEST SPECIFICATIONS

Pressure regulator	
* Fuel pressure	2,3...2,7 bar
Electric fuel pump	
* Fuel delivery (measured in return line)	at least 850 cm ³ /30s
Supply voltage (under load):	at least 12 V
Temperature sensor (air)	
* Internal electrical resistance measured at air-flow sensor between term. 4 and term. 5 at ambient temperature (+15°C...+30°C):	1450...3300 Ω
Temperature sensor (engine), plug color, blue.	
* Internal electrical resistance at ambient temperature (+ 15° C...+ 30° C):	1450...3300 Ω
with engine at normal operating temperature (approx. + 80° C):	280...360 Ω
Solenoid-operated injection valve	
* Internal electrical resistance at ambient temperature (+ 15° C...+ 30° C):	14,5...17 Ω
Air-flow sensor	
* Internal electrical resistance between:	
term.2 and term.4 :	8...2500 Ω (1)
term.3 and term.4 :	300... 550 Ω
term.1 and term.4 (CO potentiometer):	
Minimum	0...30 Ω
Maximum: the actual value measured between term.3 and term.4 is permitted to be up to 30 Ω less.	
(1) Deflect air-flow sensor flap slowly as far as it will go. Resistance fluctuates between the terminals of the potentiometer.	

TEST SPECIFICATIONS (CONTINUED)

Engine-speed sensor and reference-mark sensor	
* Internal resistance at ambient temperature (+15°C...+30°C):	400...800 Ω
* Air gap:	0,8 ± 0,5 mm
Throttle-valve switch/sensor	
* Resistance of idle contact (term.18 and term.2 or term.4 and term.6):	approx. 0 Ω
* Resistance of full-load contact (term.18 and term.3 or term.4 and term.5):	approx. 0 Ω
Idle actuator	
* Internal resistance at +15°...+30° C :	approx. 8 Ω
Lambda sensor	
* Resistance of heater winding	1...15 Ω
Ignition coil	
* Primary resistance	approx. 0 Ω
* Secondary resistance	6400...11100 Ω
Interference-suppression resistors	
* H.T. distributor rotor:	1 k Ω
The secondary side of the ignition system must feature interference suppression of at least 5 k Ω overall resistance. H.T. resistance leads are fitted as standard.	

TEST SPECIFICATIONS (CONTINUED)

Idle test:

- Engine at normal operating temp.,
switch off consuming devices.
- * Idle speed: 720...780 min ⁻¹ +)
- * Spark advance: 10 ± 5 ° crankshaft +)

Automatic transmission at N or P

CO-content: without cat. converter
% CO by vol. 0,4...1 +)

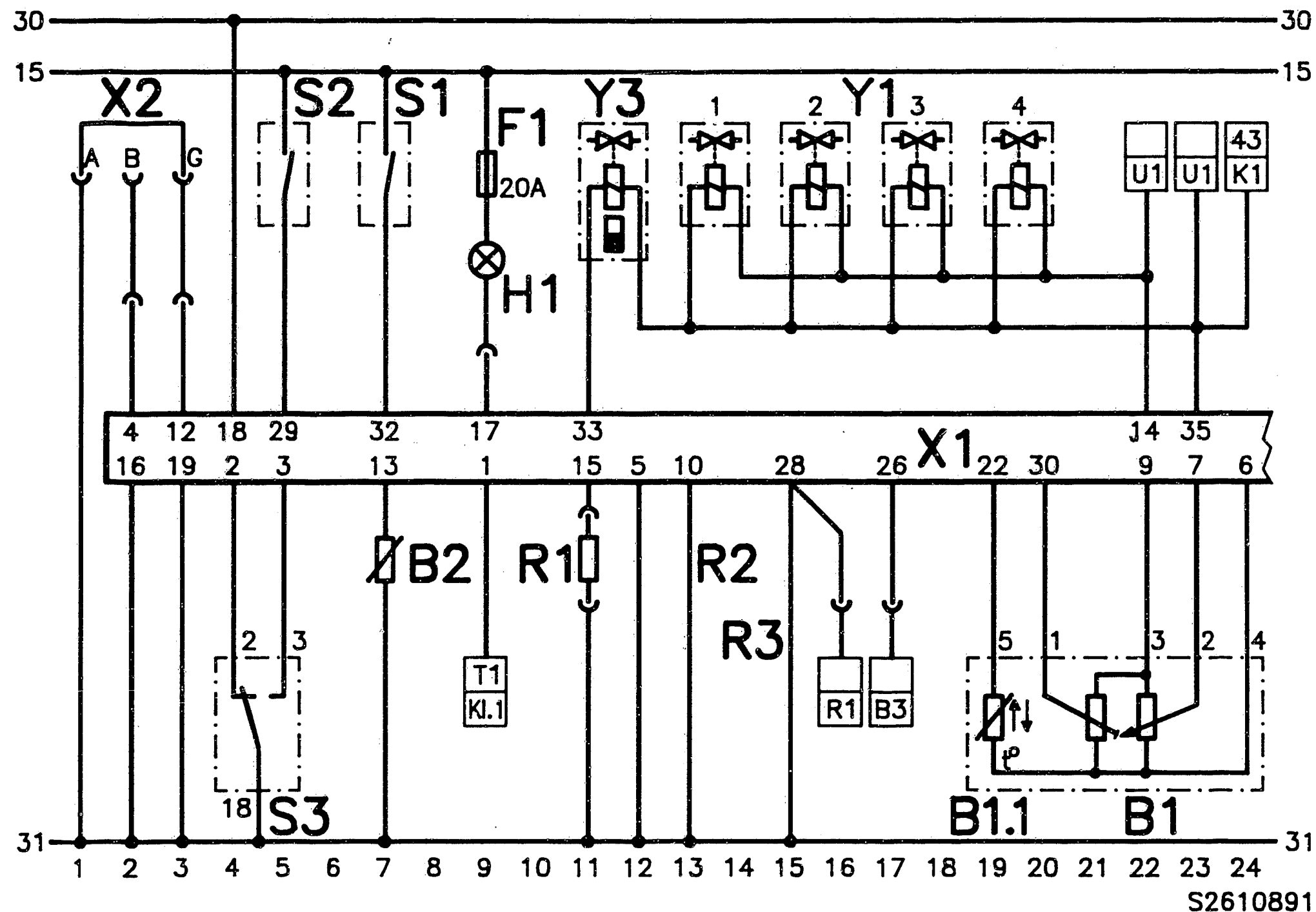
Adjust mixture at CO
potentiometer in air-flow
sensor:
Turning counterclockwise results in a leaner mixture,
turning clockwise results in a richer mixture.
Using the potentiometer, the duration of
injection can be adjusted by max. 0,5 ms

* Catalytic-converter vehicles:: 0 % CO by vol.

For production reasons:
continued on the following
coordinate.

+) Attention! The basic value stated may deviate due to
variant coding. Observe table in "Special features"
section.

See equipment and Autodata microcards for
setting values for valve clearance and other
engine-specific data.

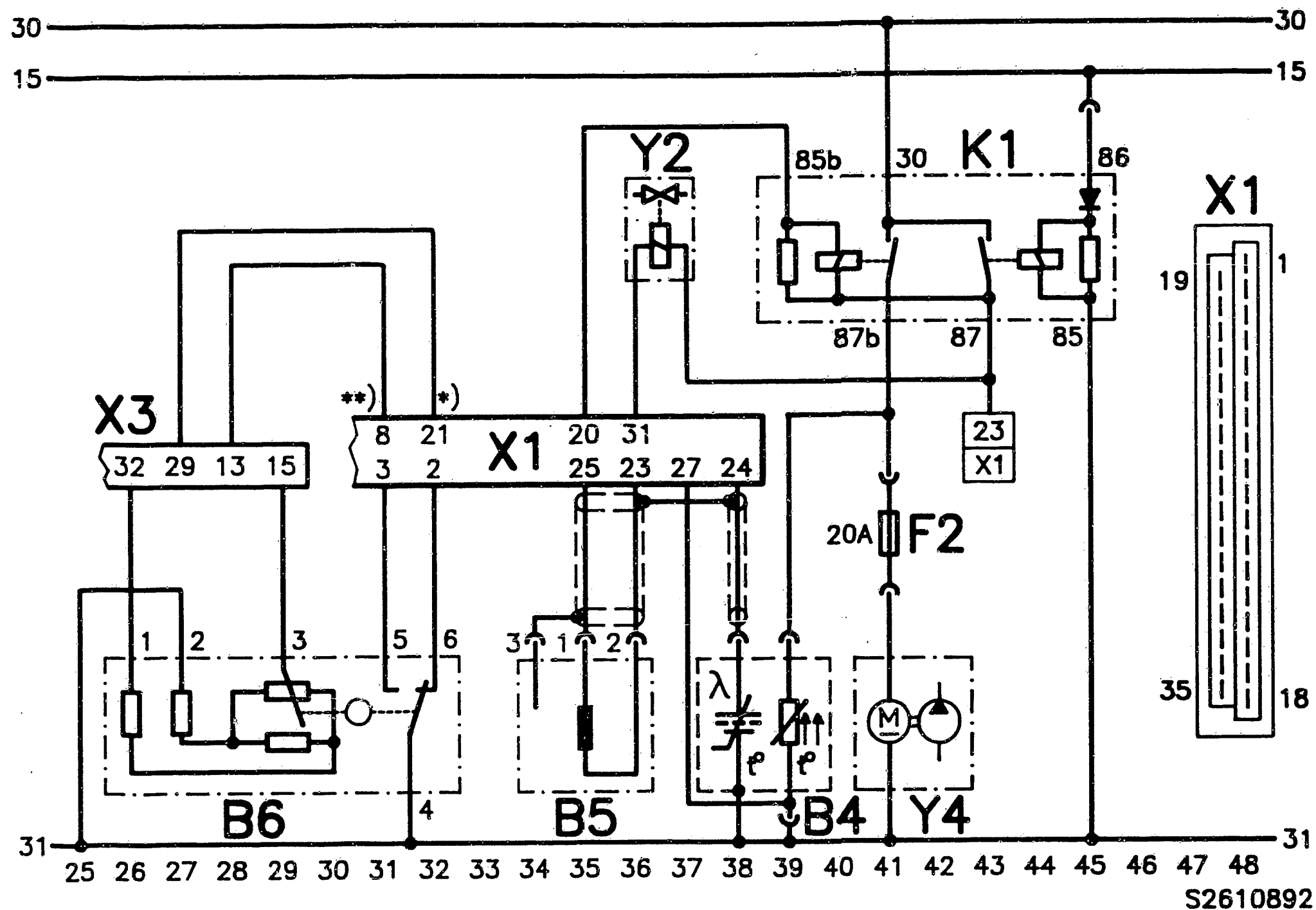


ELECTRICAL TERMINAL DIAGRAM

B1 = Air-flow sensor
 B1.1 = Temperature sensor (air)
 B2 = Temperature sensor (engine)
 B3 = Distance-travelled frequency sensor (if provided)
 F1 = Fuse 20 A
 H1 = Fault lamp

R1 = see variant encoding
 R2 = only for automatic transmission
 R3 = only for manual transmission
 S1 = A/C
 S2 = Compressor switch
 S3 = Throttle-valve switch
 T1 = Ignition coil

U1 = Vehicle computer
 X1 = Motronic control-unit plug
 X2 = Diagnosis plug
 Y1 = Injection valves
 Y3 = Idle actuator

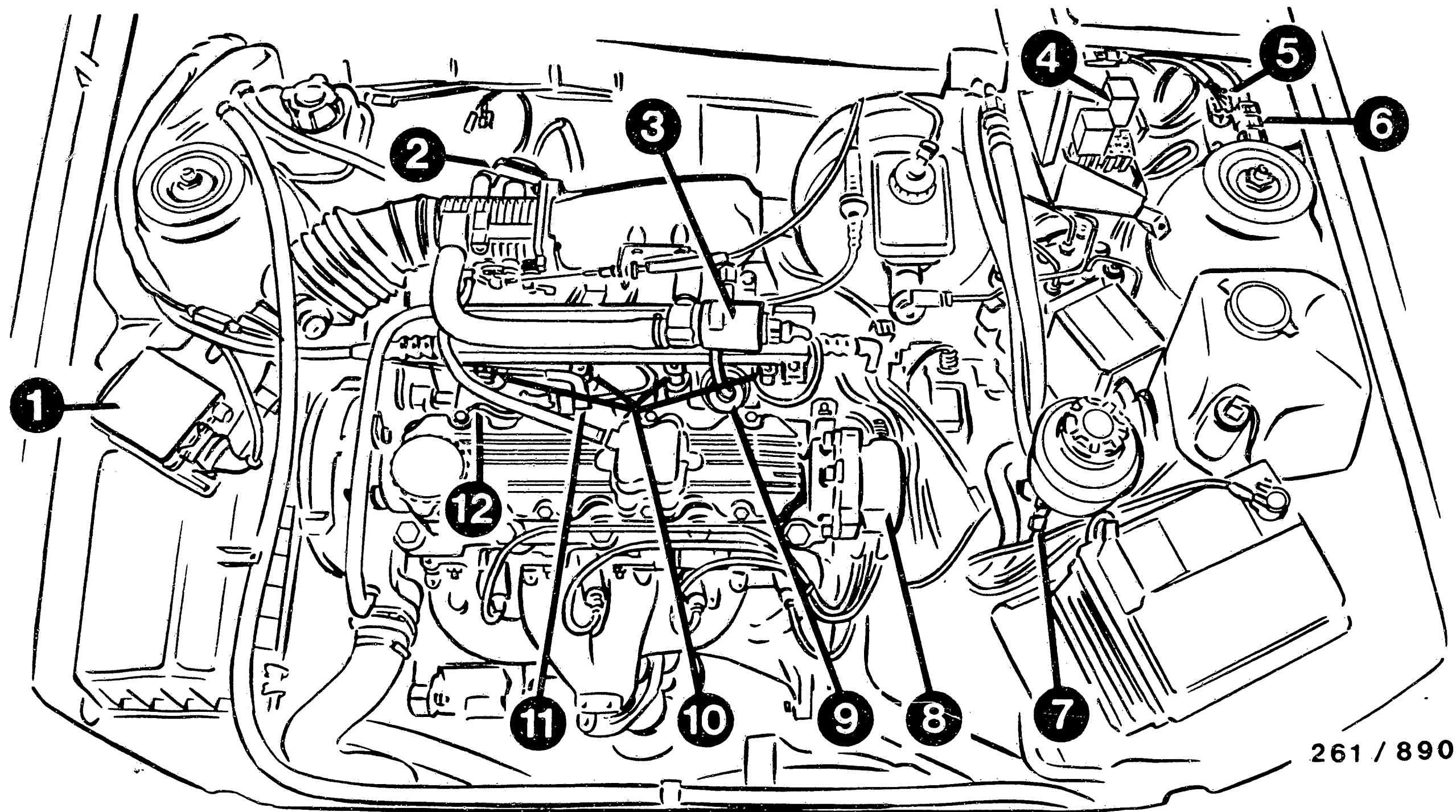


ELECTRICAL TERMINAL DIAGRAM (CONTINUED)

B4 = Lambda sensor
 B5 = Engine-speed/reference-mark sensor
 B6 = Throttle-valve switch with potentiometer for
 electronic transmission control (not from Bosch)
 F2 = Fuse 20 A
 K1 = Motronic relay
 X1 = Motronic control-unit plug

X3 = Transmission control-unit
 plug (if provided)
 Y2 = Tank ventilation valve
 Y4 = Electric fuel pump

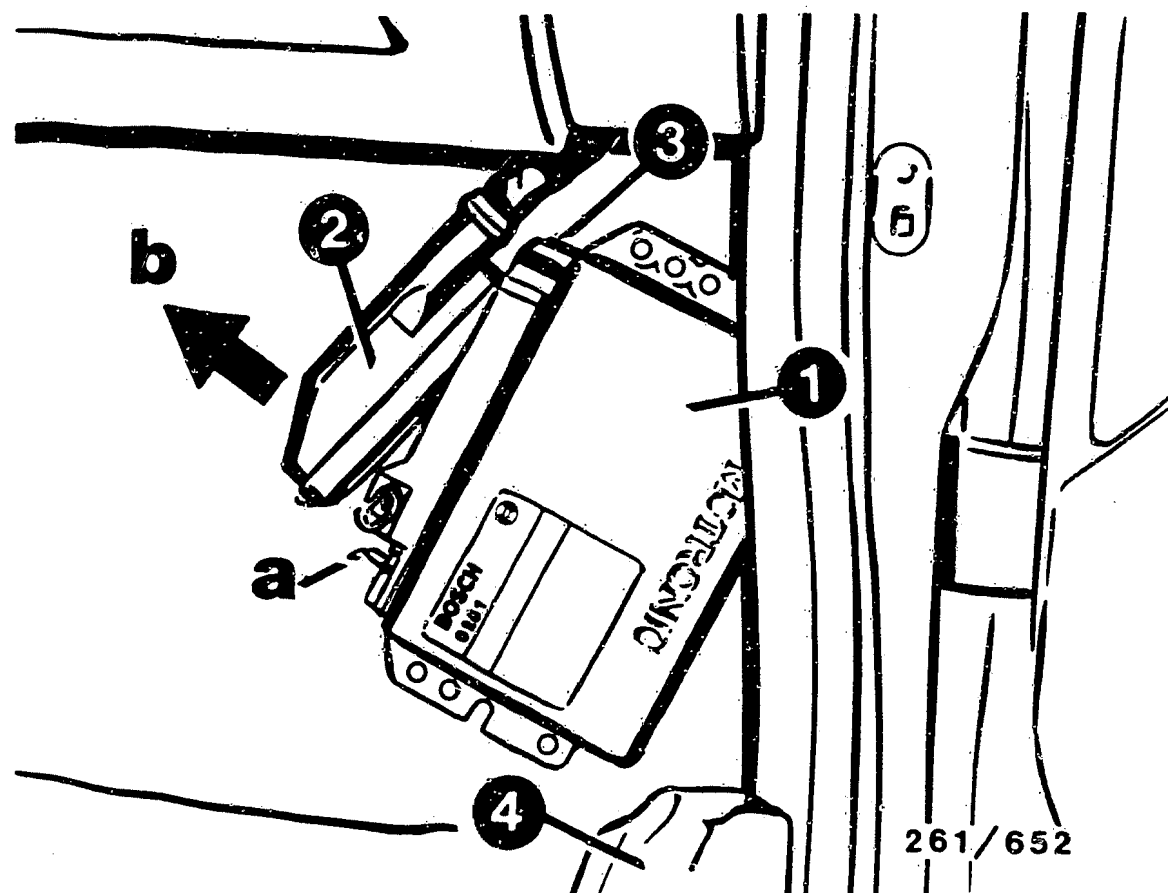
*) = Output for engine speed
 **) = Electric fuel pump



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INSTALLATION POSITION OF COMPONENTS

- | | |
|------------------------------------|-----------------------------|
| 1 = Air-flow sensor | 7 = Ignition coil |
| 2 = Throttle valve switch (sensor) | 8 = H. T. distributor |
| 3 = Idle actuator | 9 = Pressure regulator |
| 4 = Motronic relay | 10 = Injection valves |
| 5 = Diagnosis plug | 11 = Tank ventilation valve |
| 6 = Octane-number encoding plug | 12 = Ground terminals |

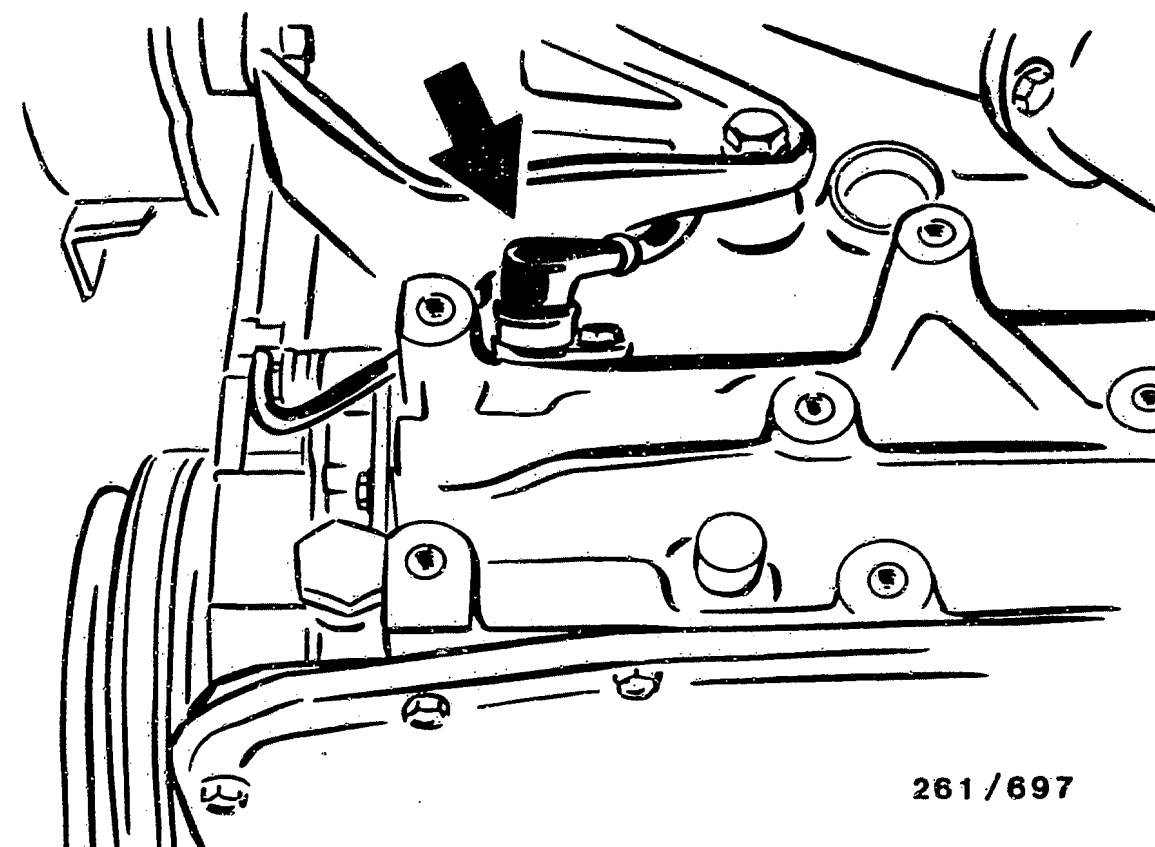


- 1 = Control unit
- 2 = Plug
- 3 = Mechanical encoding with engaging lug
- 4 = Cover over door sill

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

The installation locations always refer to the direction of travel.

- * Control unit:
In passenger-side footwell, right.
Lift plastic cover at door sill and remove control-unit cover.
Unscrew control unit. Disengage plug (a), raise (arrow b) and detach (item 3).
- * Temperature sensor (engine):
In engine block beneath alternator mount.

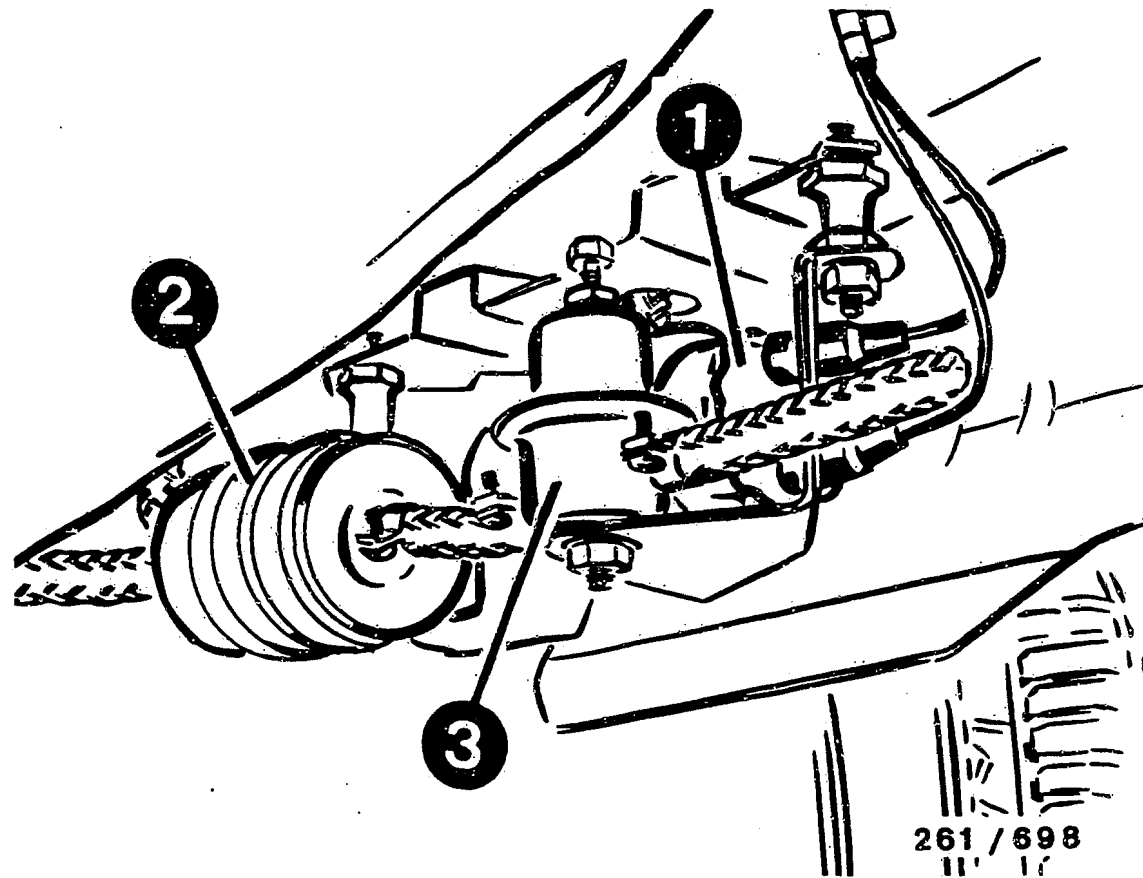


Arrow = Reference-mark/engine-speed sensor

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

- * Reference-mark/engine-speed sensor:
In engine block, left, behind V-belt pulley beneath fastening flange.
- * Lambda sensor:
In common exhaust pipe before catalytic converter.
- * Fuses:
In instrument panel at bottom left.
Fuse box can be hinged out on its lower side.
- * Temperature sensor (air):
In air-flow sensor

INSTALLATION POSITION OF COMPONENTS (CONTINUED)



- 1 = Electric fuel pump
- 2 = Fuel filter
- 3 = Pressure damper

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

- * Electric fuel pump and fuel filter:
To left of right-hand rear wheel.
- * Ground terminals:
At engine block, front right, beneath screw cover for engine oil.
- * Diagnosis plug:
In engine compartment, left at spring-strut dome.
- * Octane-number encoding plug:
In engine compartment on left at spring-strut dome.

- * Tank ventilation valve:
In engine compartment between valve cover and injection valves.
- * Carbon filter:
In right-hand front wheel house behind trim for A-pillar.

Trouble-shooting instructions : POR-5014

BOSCH system : LH 2.3-Jetronic

Make of vehicle : PORSCHE

Basic microcard : PKW-114

TABLE OF CONTENTS

Section	Coordinates
Special features, usage, safety	02
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SPECIAL FEATURES

These trouble-shooting instructions, valid at the time of publication, apply to the following PORSCHE vehicle models:

928 S 4 with and without catalytic converter as of 08.88
Engine: 4.957 l /8 cyl. M 28/41 and M 28/42
32 valve, worldwide

- * LH2.3-Jetronic with 35-pole control unit: 0 280 002 507.
- * Self-diagnosis with flashing-code output.
- * Lambda closed-loop control with adaptive basic adjustment.
- * Adaptive idle speed regulation with single-winding rotary actuator.
- * Load-dependent scavenging of active-carbon container by pulsed tank ventilation valve
- * Engine speed triggering by TN signals from term. 13 of ignition control unit.
- * Twin temperature sensor (engine) for Jetronic and ignition.
- * Vehicles with no lambda closed-loop control feature a separate idle CO potentiometer on the control-unit holder plate.
- * 8-pole control-unit encoding connection.
The country variants are realized by way of various encoding plugs.
- * 19-pole diagnosis socket on right next to passenger's seat beneath a cover.
- * Switchable intake-manifold resonance flap.
Switching conditions, engine speed greater than 3500 min⁻¹ and at least 1/3 engine load.
- * Catalytic converter protection by means of 9-pole ignition-circuit monitoring relay. 2 thermocouples monitor the exhaust-gas temperature of cyl.4/1/7/6 and 8/3/2/5. If an ignition circuit fails, the corresponding injection circuit is disconnected and this status is indicated by an LED in the relay:
red LED = ignition circuit I
green LED = ignition circuit II
At the same time, the lambda closed-loop control is deactivated.

SPECIAL FEATURES (CONTINUED)

- * Use pressure measuring device without directional-control valve for testing fuel pressure.
Carefully unscrew lock nut of test connection (at front at right-hand fuel-distribution pipe), sealing ball drops out.
Only connect up pressure gauge with hose and union nut M12x1.5.

- * The fault memory can be read out using the Pocket System Tester KTS 300 (0 684 400 300) with the program module PPG as of status 09.01.89.

Note:

Further diagnosis possibilities (actuator diagnosis etc), which would be feasible with newer program-module statuses, are not evaluated with these vehicles.

Pay attention to operating instructions for KTS 300.
Connection of the KTS 300 to the diagnosis socket in the vehicle is via the adapter lead 1 684 465 192

- * As an alternative to the KTS 300, the self-diagnosis can be read out by way of a flashing code (not possible with all control units).

Actuator and switching diagnosis is effected by way of the flashing code.

- * The self-diagnosis test table is arranged according to fault code numbers indicated by the KTS 300.
The "fault indication" column sometimes includes two types of fault optionally indicated by the tester, e.g.:
Open circ./short to ground (= 1st type of fault)
Short to positive (= 2nd type of fault)

Note: Do not detach control-unit plug and do not disconnect battery as otherwise fault memory will be cleared.

SPECIAL FEATURES (CONTINUED)

Self-diagnosis with flashing-code output:

Scope of diagnosis:

- * Readout of fault memory, self-diagnosis
Up to 11 faults can be stored including ignition-circuit monitoring relay.
- * Actuator diagnosis
- * Switching diagnosis

Test prerequisites:

- * Voltage supply, positive and negative, of control unit O.K.

Battery positive : to term. 4 direct and via main relay term. 87 to term. 9

Positive of term. 15: to term. 35

Ground: to term. 5 and term. 17

- * Diagnosis plug (arrow, next to passenger's seat)

Battery positive: to term. 12

Positive of term. 15: to term. 13

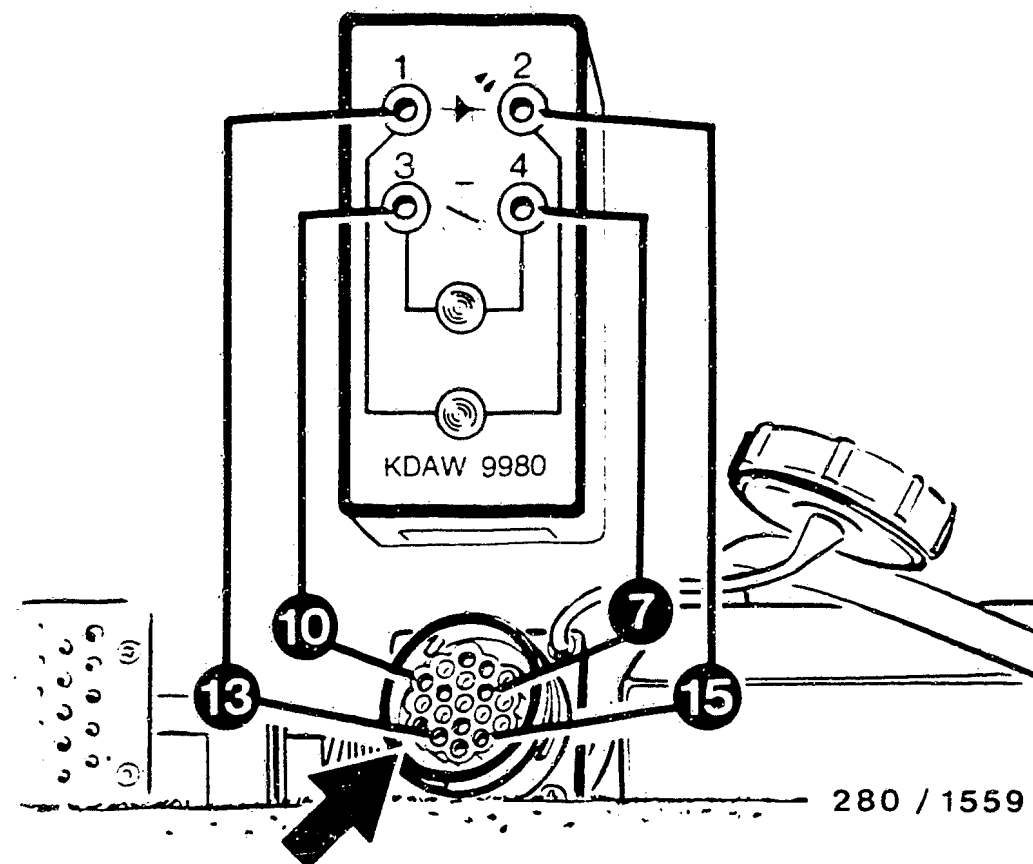
Ground: to term. 10

Lead connections:

term. 15 to control unit term. 22

term. 8 to control unit term. 12

term. 7 to control unit term. 16



SPECIAL FEATURES (CONTINUED)

Arrow = 19-pole diagnosis plug

On right next to passenger's seat beneath a cover.
The cover is secured with two knurled screws which
can be unscrewed by hand.

Flashing code:

Connect evaluation unit KDAW 9980 to diagnosis plug.

Socket: to terminal:

1 (+LED)	13
2 (-LED)	15
3 (pushbutton)	10
4 (pushbutton)	7

SPECIAL FEATURES (CONTINUED)

Conditions:

If the fault memory has been cleared,

- * Test drive for at least 5 minutes
- * Engine speed min. 1x in excess of 3000 min⁻¹
- * Fully depress accelerator pedal min. 1x
- * Coolant temperature 80°C.
- * If the engine doesn't run, start for at least 6 seconds and leave ignition "ON".

Interrogate self-diagnosis at idle speed or
with ignition "ON".

Activation of self-diagnosis:

Press pushbutton of evaluation unit for 2.5 ... 5 s.

1, 2 or 4-digit fault code is indicated by
LED flashing. Note down code.

Read out all fault codes by repeatedly pressing
pushbutton until "1" (end of fault output)
appears.

Evaluate flashing code - refer to self-diagnosis
test table.

Note:

Renewed pressing of the pushbutton triggers
the self-diagnosis of the EI-K control unit.
(Refer to SIS EI-K ignition for fault elimination).

CLEARING FAULT MEMORY:

Press pushbutton for at least 10 s whilst
fault code "1" is being displayed.

Activating actuator and switching-element diagnosis:

Keep pushbutton depressed, ignition "ON"

and press pushbutton for a further 2.5 ... 5s.

LED flashes in actuator diagnosis.

Repeated pressing of button consecutively
activates actuators and switching elements.

1st position: 1 = LH control unit

2 = EI-K control unit

2nd position: 1 = Sustained fault

2 = Sporadic fault

3 = Actuator activation

4 = Demand adaption

5 = No fault stored

3rd+4th pos. = Fault code

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!

High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

* Avoid injection of fuel when testing the compression.
To ensure this, disconnect pump relay.

For further precautionary measures, see brief instructions.

TROUBLE-SHOOTING CHART

Customer complaint (fault symptoms)

1. Starting motor operates, engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Idle problems (engine speed, exhaust gas).
4. Poor throttle take-up, flat spot during acceleration.
5. Engine missing (ignition, injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

										Cause (component fault)
*	*	*	*	*	*	*	*	*	*	* Self-diagnosis
*	*	*	*	*	*	*	*	*	*	* Actuator/switching diagnosis
*	*	*	*	*	*	*	*	*	*	Idle actuator
*	*	*	*	*	*	*	*	*	*	Air-mass meter
*	*	*	*	*	*	*	*	*	*	Intake system
*	*	*	*	*	*	*	*	*	*	Solenoid-operated injection valves
*	*	*	*	*	*	*	*	*	*	Fuel pressure/fuel pump
				*	*	*	*	*	*	Fuel delivery
			*	*	*	*	*	*	*	Throttle valve
			*	*	*	*	*	*	*	Overrun cutoff
*	*	*	*	*	*	*	*	*	*	Start control
			*	*	*	*	*	*	*	Ground connection
*	*	*	*	*	*	*	*	*	*	Alternator, interference suppress.
		*	*	*	*	*	*	*	*	CO exhaust gas setting
*	*	*	*	*	*	*	*	*	*	Control unit
			*	*	*	*	*	*	*	Catalytic converter
	*	*	*	*	*	*	*	*	*	Lambda closed-loop control
*	*	*	*	*	*	*	*	*	*	Tank ventilation system
		*	*	*	*	*	*	*	*	Ignition-circuit monitoring relay

SELF-DIAGNOSIS TEST TABLE

Pocket system tester Fault indication	Fault code	Flash- ing code	Test instructions/Test conditions	Termi- nals	Set values
Data exchange not possible	-	-	Prerequisite for fault output: Voltage supply of control unit and leads to diagnosis plug and fault lamp O.K. Voltage supply and leads O.K., however no fault output = control unit defective.	(+) 4, 9, 35, (-) 5, 17	—
—	-	1	Self-diagnosis, end of output.	—	—
No fault stored	-	15	Continue trouble-shooting with trouble-shooting chart.	—	—
Power supply outside range	11	1111 1211	Check battery and alternator. Check leads for contact resistance as well as short to positive and ground. Check main relay and control unit term. 21.	9 - 5 (+) (-)	12...14 V with engine idling
Idle switch Short to ground	12	1112 1212	Throttle-valve switch incorrectly set. Detach EI-K control-unit plug. Measure resistance directly at idle switch, Throttle valve closed: Open throttle valve somewhat: Check leads for short to ground and contact resistance. Attach EI-K control-unit plug again.	2 - 5 2 - 2	 0 Ω infinity Ω
Full-load switch Short to ground	13	1113 1213	Detach EI-K control-unit plug. Measure resistance directly at full-load switch, Throttle valve closed: Open throttle valve somewhat: Check leads for short to ground and contact resistance. Attach EI-K control-unit plug again.	3 - 5 3 - 3	 infinity Ω 0 Ω
Engine temp. sensor Op.circ./sh. to B+ Short to ground	14	1114 1214	Measure resistance directly at temperature sensor, +15...+30°C: approx. +80°C: Check leads for open circuit (op.circ.) as well as short to positive (sh. to B+) and ground.	13 - 5 13	1.45...3.3 k Ω 280...360 Ω

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flash- ing code	Test instructions/Test conditions	Termi- nals	Set values
Air-mass sensor Signal outside range	21	1121 1221	Measure voltage directly at connector, switch on ignition and start engine: Voltage is a function of load: With engine stopped detach connector. Measure resistance directly at air-mass sensor: Check leads for contact resistance. Attach connector to air-mass sensor.	(+) (-) 2 - 4 5 - 3 5 - 3	8...15 V 2...5 V 3.6...4.1 Ω
Idle actuator outside range	22	1122 1222	Measure voltage directly at connector, switch on ignition and start engine: Test signal at control unit. With engine stopped, measure resistance at idle actuator:	9 - 33 (+) (-)	8...15 V 4...12 Ω
Lambda control outside max. range	23	1123 1223	Control unit detects lean mixture, control effects enrichment. Check sensor lead for short to ground (shield). Test sensor heater, resistance: supply voltage: Sensor ceramic clogged. Intake system leaking (leakage air). Fuel pressure too low, set value:	24 - 5	1...15 Ω 8...15 V 3.6...4.0 bar
Lambda control outside min. range	24	1124 1224	Control unit detects rich mixture, control effects leaning. Check sensor lead for interference and sensor for connection to heater positive. Check ground connection. Check sensor heater, resistance: supply voltage: Fuel pressure too high, set value: Tank ventilation valve permanently open.	24 - 5	1...15 Ω 8...15 V 3.6...4.0 bar
Oxygen sensor control interrupted	25	1125 1225	Check sensor lead for open circuit as well as short to ground/heater positive. Check sensor heater, resistance: supply voltage: Sensor ceramic defective.	24 - 5	1...15 Ω 8...15 V
Catalytic conv. protection function active	31	1131	LED on ignition-circuit monitoring relay lights up: Red LED = I (cyl.1,4,6,7), green LED = II (cyl.2,3,5,8) Check thermocouples, ignition-circuit monitoring relay, ignition and injection valves of failed circuit.		
Control unit Digital sec.(comput) defective	41	1141	LH-control unit defective, renew.		

ACTUATOR / SWITCHING DIAGNOSIS TEST TABLE

Flashing code	Testing of component/function	Test instructions / Test conditions	Terminals	Set values
1 3 1 1	Injection valves, leads/actuation of valves	Detach plug from all injection valves. Connect one injection valve in each case. This must be heard to function. Check all injection valves one after the other. Measure resistance directly at injection valve: + 15...+30°C; Check leads from control unit and main relay (via ignition-circuit monitoring relay) to injection valves for short circuit/open circuit.	18 - 9 (-) (+)	14.5...17.5 Ω
1 3 2 1	Idle rotary actuator, leads/actuation of idle actuator	Idle actuator must be heard or felt to function. Measure resistance directly at idle actuator: Check leads from control unit and main relay to idle actuator for short circuit/open circuit.	33 - 9 (-) (+)	4...12 Ω
1 3 2 2	Tank ventilation valve, leads/actuation	Tank ventilation valve must be heard or felt to function. Measure resistance directly at valve: Check leads from control unit and main relay to ventilation valve for short circuit/open circuit.	27 - 9 (-) (+)	35...55 Ω
1 3 2 3	Resonance flap, leads/actuation	Resonance flap must be heard or felt to function. Check leads from control unit and main relay to valve for flap for short circuit/open circuit.	34 - 9 (-) (+)	
1 3 3 1	EI-K control unit, leads/engine-speed signal to LH-control unit	Actuate starting motor for approx. 5s. Check leads from term. 1 to EI-K control unit term. 13 and ground lead term. 17 for open circuit.	1 - 17 (+) (-)	

ACTUATOR/SWITCHING-ELEMENT DIAGNOSIS TEST TABLE

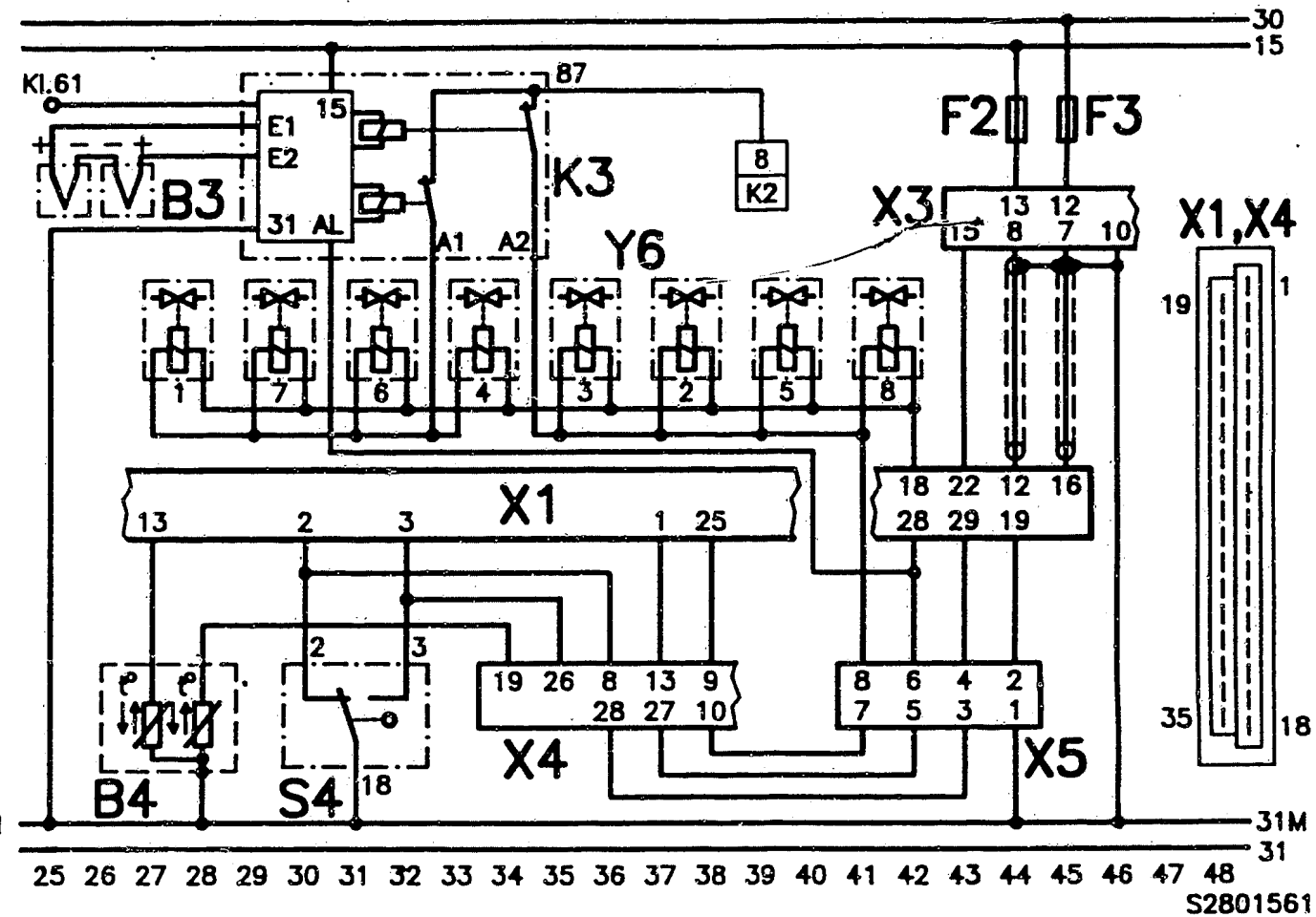
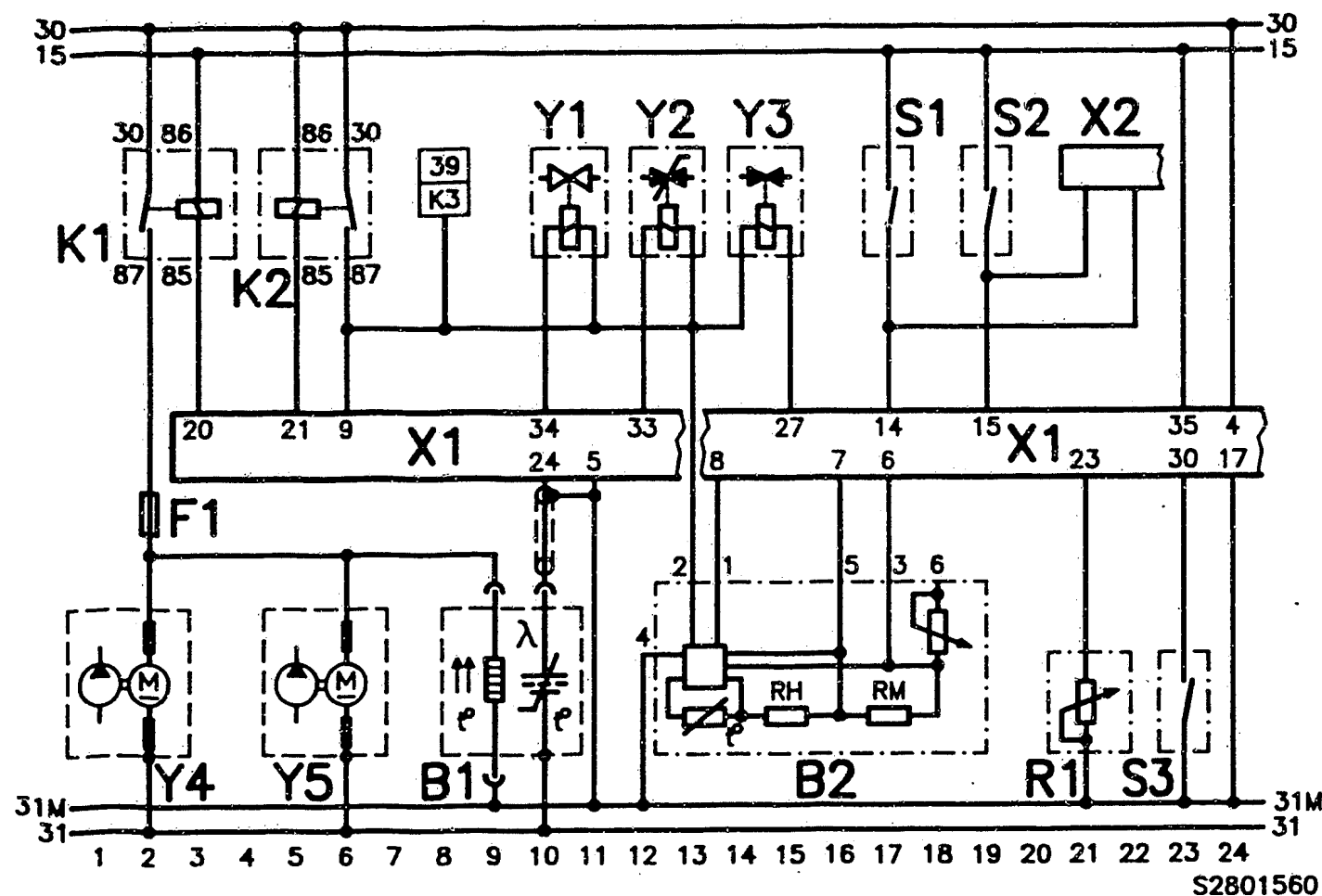
Flashing code	Testing of component/function	Test instructions/Test conditions	Terminals	Set values
1 3 3 2	Throttle-valve switch, leads/adjustment, idle contact	Slightly open throttle valve during flashing phase. Flashing code goes out if signal is O.K. Throttle-valve switch incorrectly set. Detach EI-K control-unit plug. Measure resistance directly at idle switch, Throttle valve closed: Throttle valve open: Test leads for contact resistance. Re-attach EI-K control-unit plug.	2 - 5 2 - 2	 0 Ω infinity Ω
1 3 3 3	Throttle-valve switch, leads/full-load contact	Completely open throttle valve during flashing phase. Flashing code goes out if signal is O.K. Detach EI-K control-unit plug. Measure resistance directly at full-load switch, Throttle valve closed: Completely open throttle valve: Test leads for contact resistance. Re-attach EI-K control-unit plug.	3 - 5 3 - 3	 infinity Ω 0 Ω
1 3 3 4	Switch, leads/A/C readiness	Switch on A/C during flashing phase. Flashing code goes out if signal is O.K. Test A/C switch Test leads from ignition and starting switch and ctrl. unit to A/C switch for short-circ./open-circ.	15 - 5	
1 3 3 5	Switch, leads/A/C compressor	Switch on A/C during flashing phase. Flashing code goes out if signal is O.K. Test A/C switch. Test leads from ignition and starting switch and ctrl. unit to A/C switch for short-circ./open-circ.	14 - 5	
1 3 3 6	Drive switch Automatic transmission	Only for vehicles with automatic transmission. During flashing phase, shift selector lever from P or N into a driving position. Flashing code goes out if signal is O.K.	30 - 17	

TEST SPECIFICATIONS

Component/function	Set values
Electric fuel pump	
* Delivery at return:	min. 1250 cm ³ /30 s
* Supply voltage under load:	min. 12 V
* Delivery of pre-supply pump:	min. 1350 cm ³ /30 s
Pressure regulator	
* Fuel pressure with engine stopped: when idling:	3,6...4,0 bar approx. 0.5 bar less
Fuel system, leakage	
* Fuel pressure after engine stopped for 20 min.:	min. 1.0 bar
Idle actuator	
* Resistance at +15...+30°C :	4...12 Ω
Hot-wire air-mass meter	
* Resistance between term. 6 and term. 3:	0...1100 Ω
term. 5 and term. 3:	3.6...4.1 Ω
Temperature sensor (engine)	
Twin version	
* Resistance at ambient temperature +15...+30°C:	1.45...3.3 k Ω
with engine at operating temperature approx. +80°C :	280...360 Ω
Solenoid-operated injection valve	
* Resistance at ambient temperature +15...+30°C:	14.5...17.5 Ω
* Leakage after 60 s:	no droplets may drip off
Start control	
* Voltage at injection valve at commencement of starting: after approx. 15 s:	greater than 1.5 V approx. 0.5 V

TEST SPECIFICATIONS (CONTINUED)

Component/function	Set values
Idle adjustment	
Eng. at op. temp., approx. +80°C	
* Idle speed:	650...700 min ⁻¹
Setting:	not necessary since engine-speed regulation is adaptive
CO setting	
Eng. at op. temp., approx. +80°C	
* Vehicles with no lambda closed-loop control:	0,5...1,5 vol.% CO
Setting on CO potentiometer beneath control unit.	
* Vehicles with lambda closed-loop control:	0,4...1,2 vol.% CO
Sensor plug connected together (CO sampling ahead of catalytic converter)	
Setting:	Not necessary since lambda control is adaptive
Lambda sensor heater	
* Internal resistance (PTC) with engine stopped:	1...15 Ω
Tank ventilation valve	
* Internal resistance:	35...55 Ω
Lambda closed-loop control	
Testing with tester 0 684 101 810	
* Open-loop control (press both buttons 0.1 V and 0.9 V):	Sensor voltage: Fixed voltage value Approx. 0.1 V or approx. 0.9 V
* Closed-loop control (do not press any buttons):	Reading fluctuates between 0.1 V and 0.9 V
* Setting:	Not necessary since lambda control is adaptive
* Rich value (press 0.1 V button for lean simulation):	approx. 0.9 V
* Lean value (press 0.9 V button for rich simulation):	approx. 0.1 V
Refer to equipment and Autodata microcard for settings as regards ignition and valve clearance as well as other engine-related data.	



ELECTRICAL TERMINAL DIAGRAM

B1 = Heated lambda sensor
 B2 = Hot-wire air-mass meter
 B3 = Thermocouples
 B4 = Twin temperature sensor
 K1 = Pump relay
 K2 = Main relay
 K3 = Ignition-circuit monitoring relay
 R1 = Idle potentiometer

S1 = A/C compressor switch
 S2 = A/C readiness switch
 S3 = Drive switch (automatic only)
 S4 = Throttle-valve switch
 X1 = Control-unit plug-Jetronic
 X2 = A/C plug
 X3 = Diagnosis plug, 19-pole
 X4 = Control-unit plug-ignition

X5 = Encoding connection
 Y1 = Intake-manifold resonance flap
 Y2 = Idle actuator
 Y3 = Tank ventilation valve
 Y4 = Electric fuel pump
 Y5 = Pre-supply pump
 Y6 = Solenoid-operated injection valves

INSTALLATION POSITION OF COMPONENTS

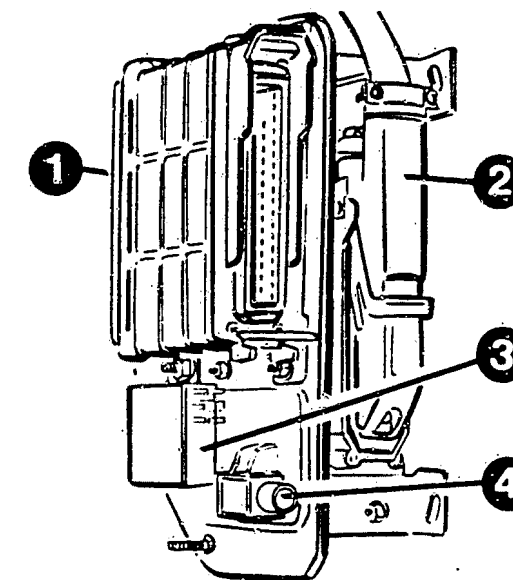
The installation locations always refer to the direction of travel.

* Top picture

The EI-K control unit (1) and LH control unit (2) are located in the passenger-side footwell on the right behind a cover.

The ignition-circuit monitoring relay (3) is likewise attached to the control-unit holder plate.

Located beneath this in vehicles with no lambda closed-loop control is the separate idle CO potentiometer (4).



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* Center picture

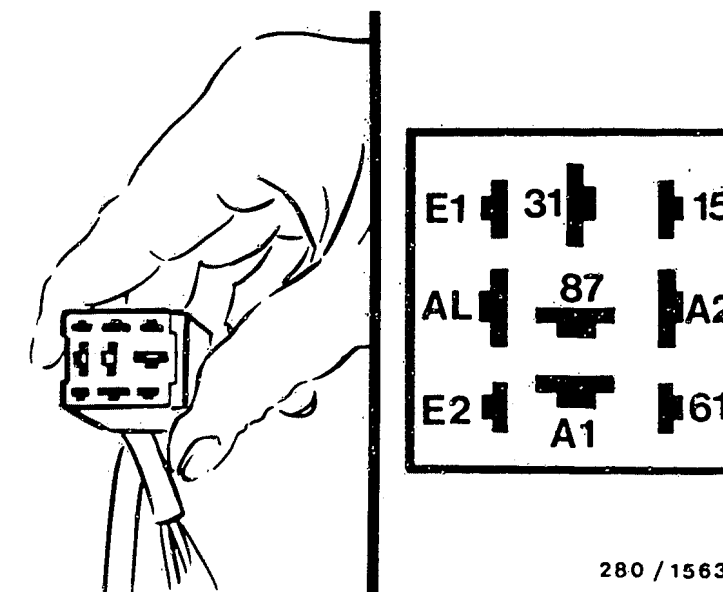
Top view of plug-in frame.

Ignition-circuit monitoring relay detached.

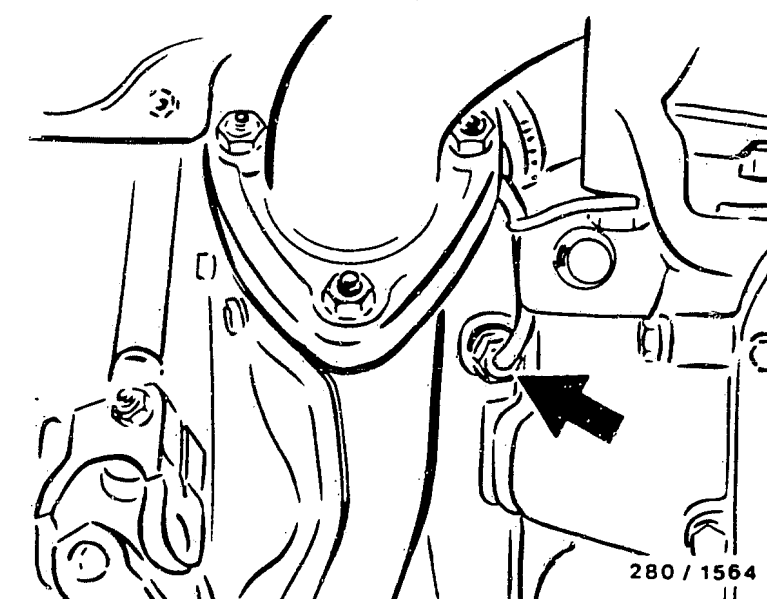
* Bottom picture

Arrow = Thermocouple

The two thermocouples are located at the exhaust ports of cylinders 4 and 8.



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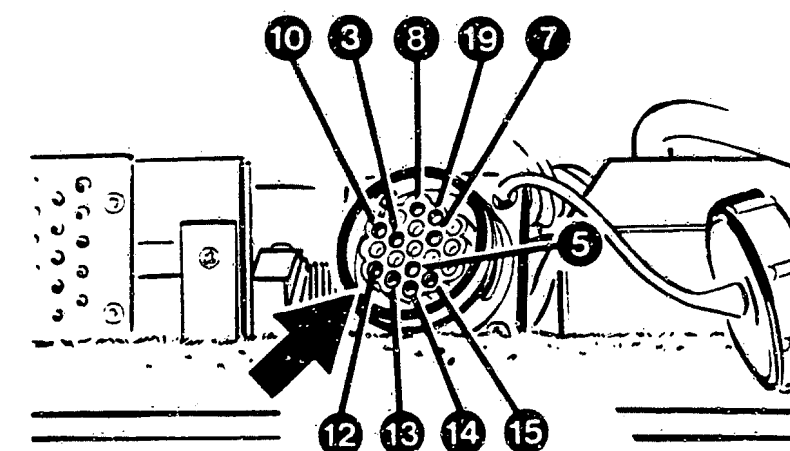


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INSTALLATION POSITION OF COMPONENTS (CONTINUED)

* Top picture

Arrow = 19-pole diagnosis plug with assigned terminals.
On the right next to the passenger's seat beneath a cover.
The cover is secured with two knurled screws which can be loosened by hand.



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* Center picture

The central-electrics console is located in the passenger-side footwell. It becomes accessible after folding back the floor mat and pivoting up the floor panel.

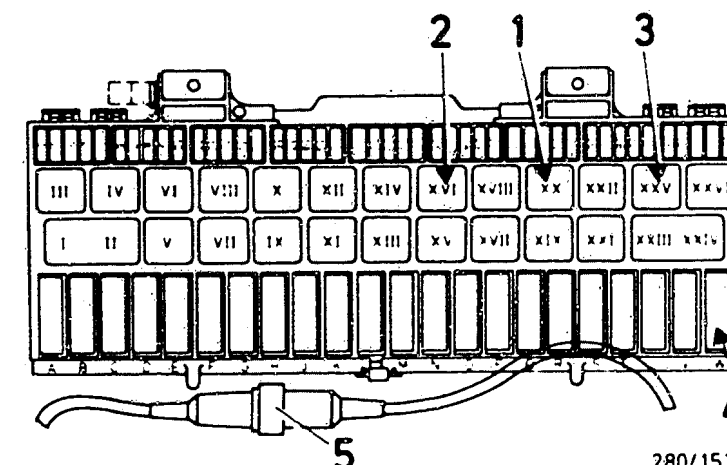
1 = Pump relay for LH-Jetronic

2 = Relay for EI-K control unit

3 = Main relay for LH-Jetronic

4 = Plug for power supply of EI-K and LH control unit.

5 = Lambda-sensor plug connection



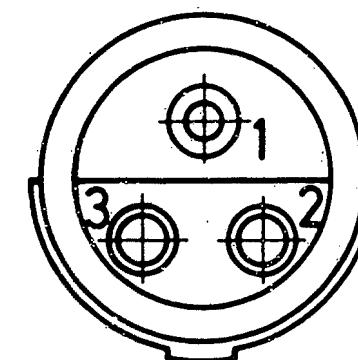
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* Bottom picture

Assignment of lambda-sensor plug

1 = Sensor voltage, black lead

2,3 = Heater, white leads



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INSTALLATION POSITION OF COMPONENTS (CONTINUED)

Components on engine

* Top picture

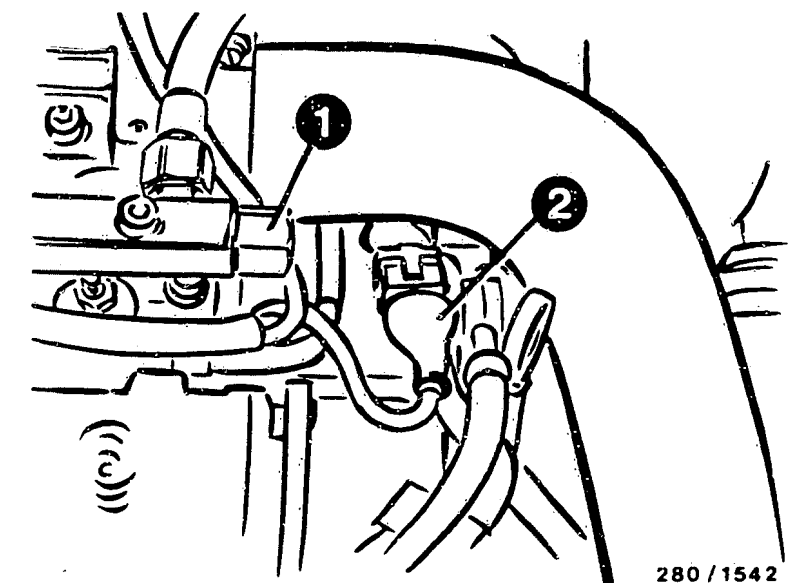
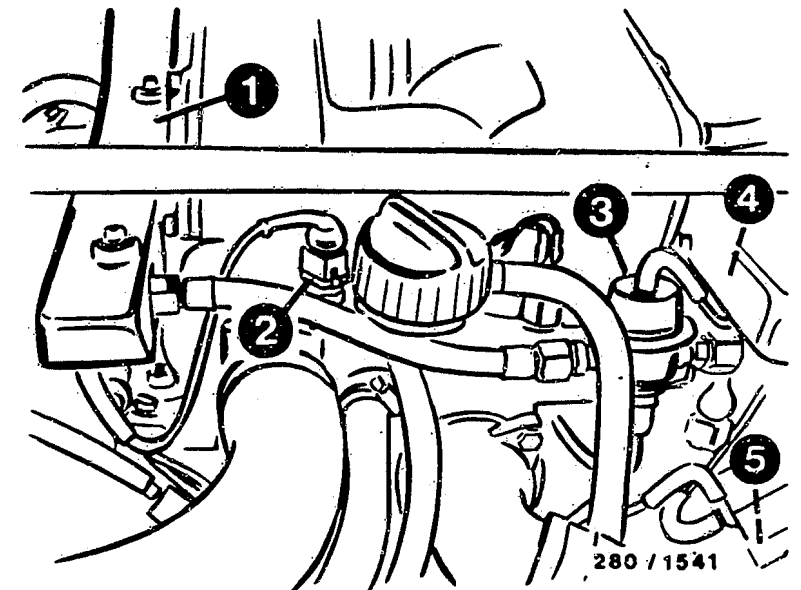
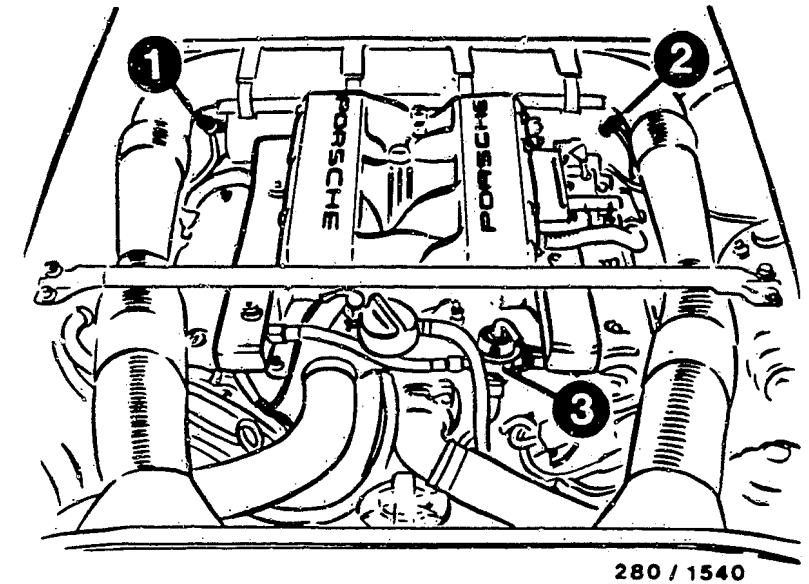
- 1 = CO sampling point for right-hand cylinder bank
- 2 = CO sampling point for left-hand cylinder bank
- 3 = Fuel pressure regulator

* Center picture

- 1 = Right-hand fuel-distribution pipe with solenoid-op.inj. valves
- 2 = Twin temperature sensor (engine) for Jetronic and EI-K control unit.
- 3 = Fuel pressure regulator
- 4 = Left-hand fuel-distribution pipe with solenoid-operated inj. valves
- 5 = Solenoid valve for intake-manifold resonance flap

* Bottom picture

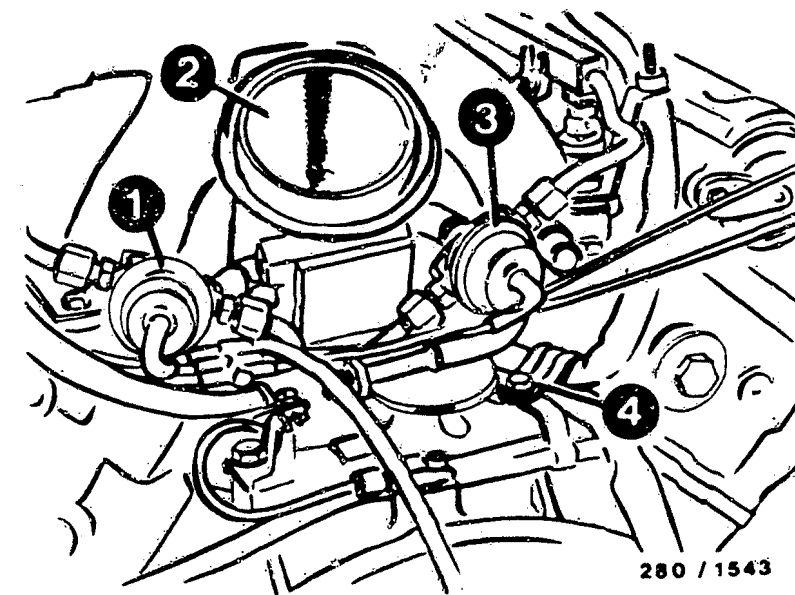
- 1 = Right-hand fuel-distribution pipe with solenoid-operated inj. valves
- 2 = Tank ventilation valve



INSTALLATION POSITION OF COMPONENTS (CONTINUED)

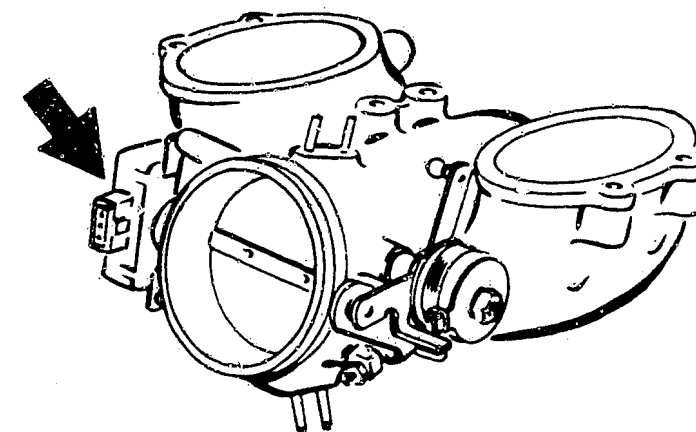
* Top picture

- 1 = Fuel pressure damper
- 2 = Hot-wire air-mass meter
- 3 = Fuel pressure damper
- 4 = Electronics ground



* Center picture

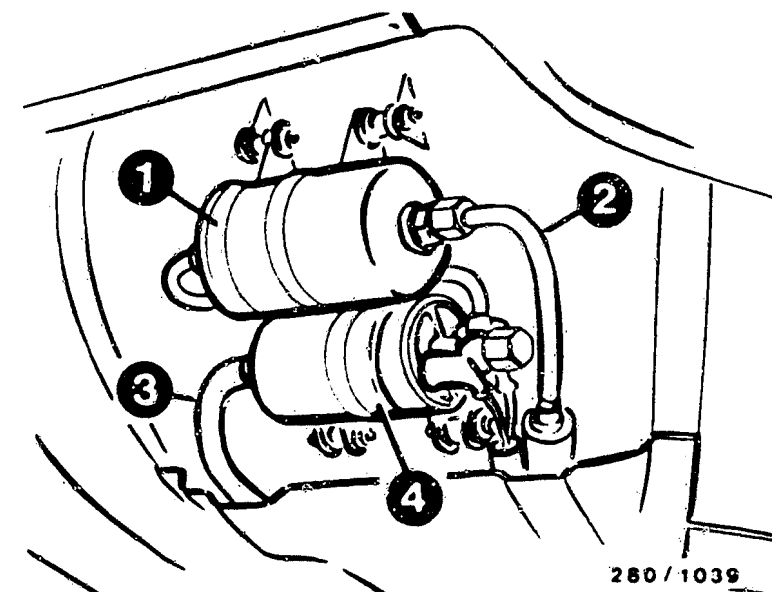
Arrow indicates throttle-valve switch on removed throttle-valve assembly (time required for removal: approx. 6 hours).



Fuel supply components

* Bottom picture

- 1 = Fuel filter
- 2 = Fuel delivery tubing
- 3 = Fuel intake line
- 4 = Electric fuel pump



SPECIAL FEATURES (CONTINUED)

2. Attach EI-K control-unit plug.
Connect voltmeter to ignition-distributor
plug term. 24 (+) and vehicle ground (-).

N o t e:

Use voltmeter with internal resistance
(Ri) greater than 50 k Ω /V (otherwise
incorrect measurement).

Ignition ON.

Set value: equal to/greater than 2 V

Renew EI-K control unit if set value
was not attained.

Renew magnetic pulse generator or
ignition distributor if items 1 and 2 O.K.

* Perform trouble-shooting and fault elimination
for test step EI-K CONTROL-UNIT FUNCTION as
follows:

If set value (rectangular pulse at least 2.5 V)
was not attained, check lead from EI-K control
unit term. 16 to trigger-box plug term. 2 for
open circuit or short to ground.

Eliminate open circuit, short to ground.

Attach EI-K control-unit plug.

Detach trigger-box plug and connect resistance
of 240...270 Ω (e.g. commercially available
decade resistor) to term. 2 and term. 3.

Connect oscilloscope "special" with red terminal
to trigger-box plug term. 2 (+).

Black terminal to vehicle ground (-).

Start engine.

Oscilloscope must indicate a rectangular pulse
of at least 2.5 V.

Renew trigger box if set value attained.

Renew EI-K control unit if set value not
attained.

STRUCTURE AND USAGE

These brief instructions encompass essentially
vehicle-specific special features and test
specifications (set values).

In accordance with the customer complaint,
the trouble-shooting chart leads to different
causes/component faults.

For a detailed description of trouble-shooting,
see the information in the trouble-shooting
chart of the basic instructions.

ATTENTION: Even if reference is made to
basic instructions, the set values, terminal
assignments and special features of these
vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to
avoid damage to the engine, trigger boxes and
control units or to the ignition system,
observe the information in the basic instructions.

CAUTION!

High-performance ignition system with
dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals
may prove fatal (both on the primary and
secondary sides).

TROUBLE-SHOOTING CHART

Customer complaint (symptoms of trouble)

- Starting motor operates, engine fails to start or starts only with difficulty
- Engine starts but then dies
- Idle problems (engine speed, exhaust)
- Poor throttle response.
- Engine missing (ignition, injection)
- Insufficient maximum power/speed
- Excessive fuel consumption
- Engine diesels
- Engine pings/knocks
- Engine overheats
- Fault lamp.

Cause (component fault)										
*	*	*	*	*	*	*	*	*	*	Self-diagnosis
*			*							High-voltage side
*			*							Ignition coil
*										Firing sequence
*										Voltage - EI-K control unit
*										Ignition-distributor plug and socket
*										Voltage, magnetic pulse generator
*										Function, magnetic pulse generator
*										EI-K control units, function
*										Voltage, trigger box
*										Primary signal
*										Triggering, electric fuel pump relay

TROUBLE-SHOOTING CHART (Continued)

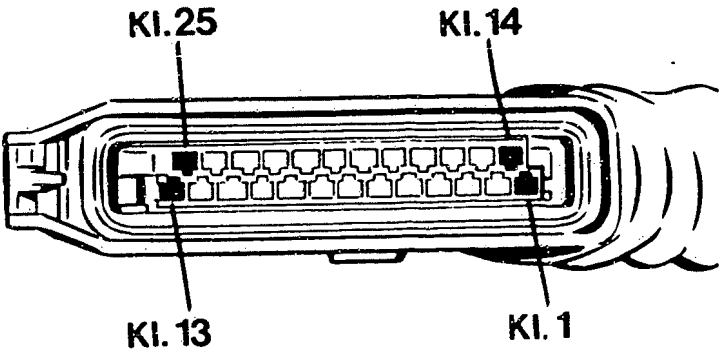
Customer complaint (fault symptoms)

- Starting motor operates, engine fails to start or starts only with difficulty.
- Engine starts but then dies.
- Idle problems (Engine speed, exhaust gas).
- Poor throttle take-up, flat spot during acceleration.
- Engine missing (ignition, injection).
- Maximum engine power/top speed not reached.
- Fuel consumption too high.
- Engine running on (dieseling).
- Engine pinging/knocking.
- Engine overheating.
- Fault lamp.

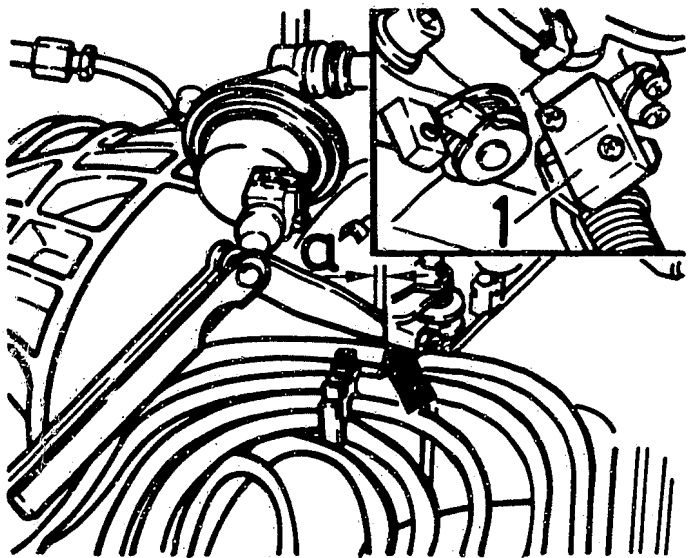
Cause (component fault)										
*										Contact resistance
*										Ignition-distributor as-assembled setting
*				*	*		*	*	*	Basic ignition setting
			*							Voltage, EI-K control unit
			*							Voltage, ignition coil

SELF-DIAGNOSIS TEST TABLE

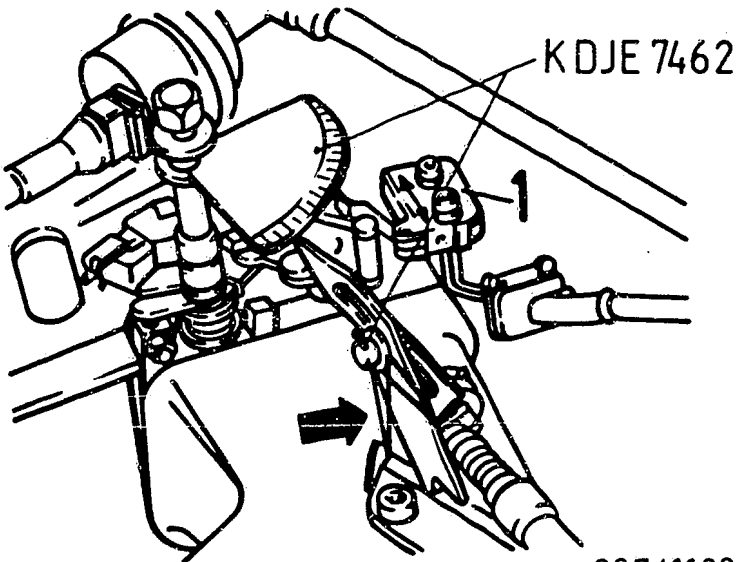
Fault display Flash code	Testing of component/function Test instructions/conditions	Term.	Set values
1 1 1 1	EI-K CONTROL UNIT Replace EI-K control unit.	—	—
2 1 2 1	THROTTLE-VALVE SWITCH - IDLE Voltage, EI-K control-unit plug. Upper illustration. Throttle valve in idle position. Ignition ON. Feeler gauge 0,5...0,7 mm between throttle-valve stop and adjusting screw. See center illustration, arrow.	7 20 (+) (-)	approx. battery voltage 0 V
2 1 2 3	THROTTLE-VALVE SWITCH - FULL LOAD Voltage, EI-K control-unit plug. Throttle valve in idle position. Ignition ON. Graduated disc on throttle valve level 1. See lower illustration, arrow. 68...76° after idle position.	9 20 (+) (-)	0 V approx. battery voltage.



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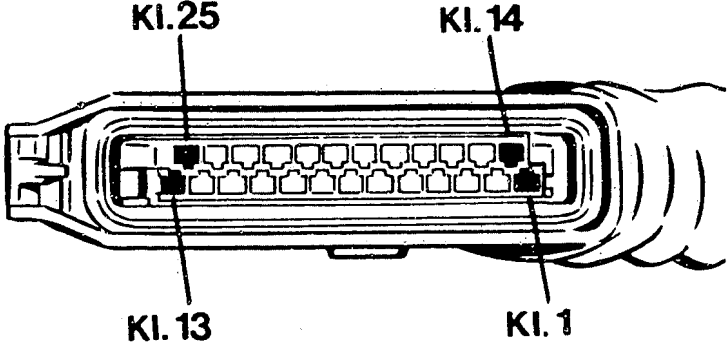
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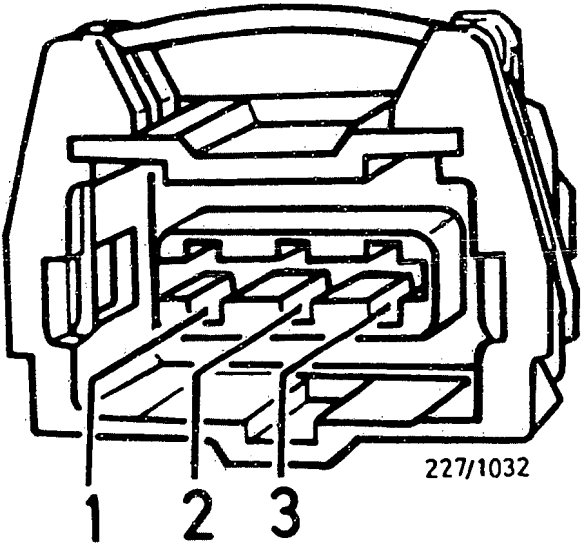
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SELF-DIAGNOSIS TEST TABLE (Continued)

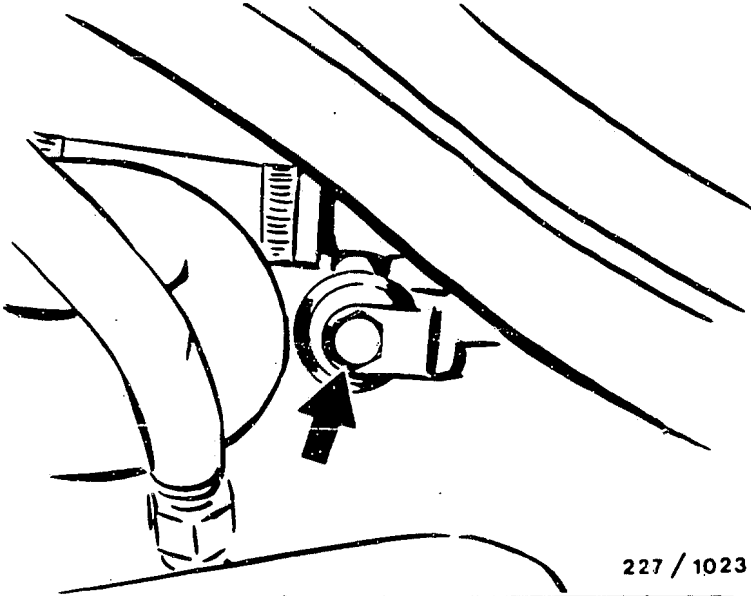
Fault display Flash code	Testing of component/function Test instructions/conditions	Term.	Set values
2 1 4 1	MAXIMUM RETARDATION OF KNOCK CONTROL Fuel with insufficient octane number, Check ignition-point adjustment, fuel- injection. Bearing damage, abnormal engine noises.	—	—
2 1 4 2	KNOCK SENSOR Resistance of EI-K control-unit plug (upper illustration) and knock-sensor plug connection (center illustration). Resistance of knock-sensor plug connec. See center illustration. Tightening torque. See lower ill., arrow.	13 1 12 2 12 3 1 2	approx. 0 Ω approx. 0 Ω approx. 0 Ω infinite Ω 15-25 Nm
2 2 2 3	ALTITUDE SENSOR Voltage of EI-K control-unit plug. See upper illustration. Ignition ON.	2 20 (+) (-)	Sea level = 3,2...4,7V 500 m = 2,8...4,0V 1000m = 2,4...3,5V 1500m = 2,0...3,0V 2000m = 1,5...2,5V 3000m = 0,8...1,6V



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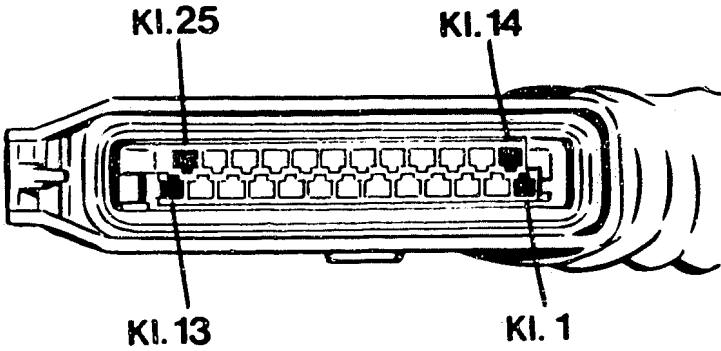
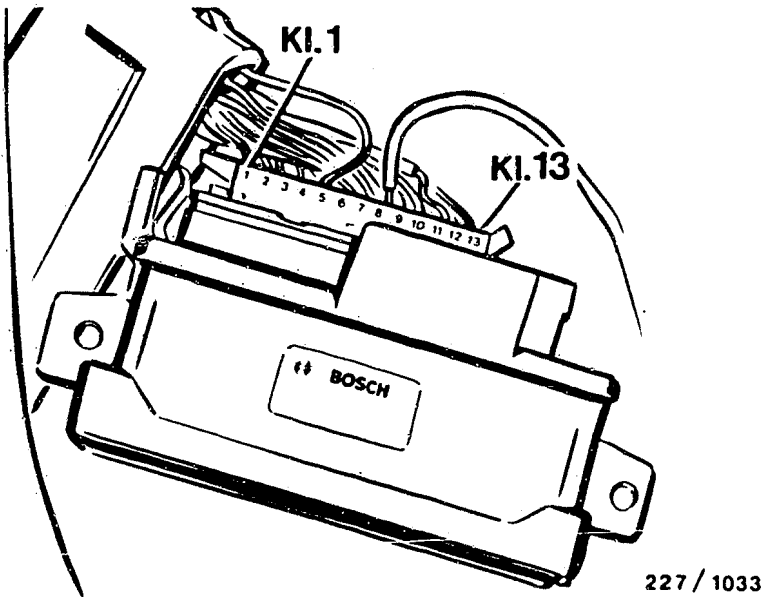
227/1032



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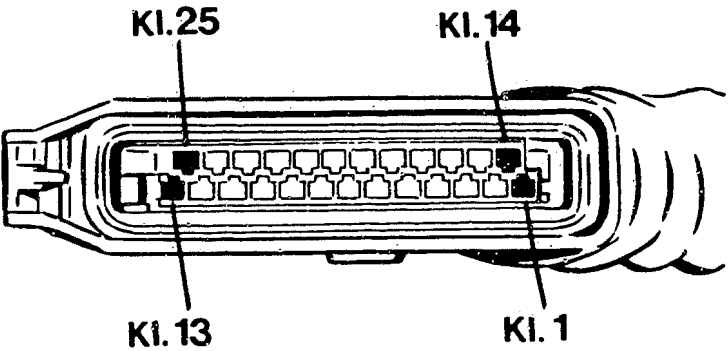
SELF-DIAGNOSIS TEST TABLE (Continued)

Fault display Flash code	Testing of component/function Test instructions/conditions	Term.	Set values
2 2 3 2	LOAD SIGNAL Voltage, EI-K control-unit plug with handle cover removed. See upper illustration. Engine at idle.	8 20 (+) (-)	0,2...4,6 V
2 2 3 3	REFERENCE VOLTAGE FOR LOAD- AND ALTITUDE-SENSOR SIGNAL Voltage, EI-K control-unit plug. See lower illustration. Ignition ON.	21 20 (+) (-)	4,5...5,1 V
2 3 1 2	TEMPERATURE SENSOR - COOLANT Resistance of EI-K control-unit plug. See lower illustration.	25 20	+ 20°C=2,1...2,9k Ω + 30°C=1,4...2,0k Ω + 80°C=280...370 Ω + 90°C=210...280 Ω +100°C=160...210 Ω
4 4 4 4	NO FAULT IN MEMORY	—	—
0 0 0 0	END OF FAULT OUTPUT	—	—

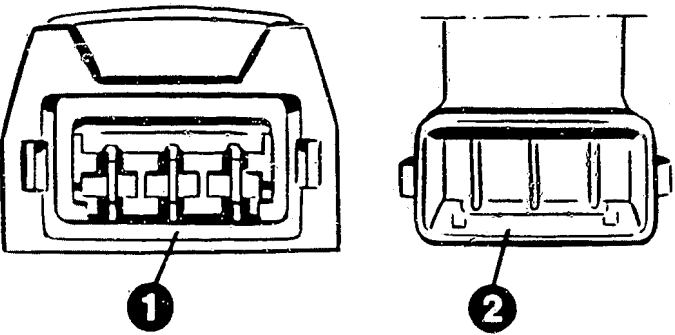


RAPID DIAGNOSIS CHART

Test step	Testing of component/function Test instructions/conditions	Term.	Set values
1	HIGH-VOLTAGE SIDE For example, check spark plugs, ignition harness, distributor cap, etc. for proper operation (e.g. open circuits, shunt). Evaluate with ignition oscillogram, resistance measurement, visual check for example.	—	—
2	IGNITION COIL Visual check (Bosch only): Are seal plugs present, has sealing compound escaped? Primary resistance (Bosch) Secondary resistance (non-Bosch) Primary resistance (Bosch) Secondary resistance (non-Bosch)	— 1 15 1 15 1 4 1 4	— 0,6... 1,0 Ω 0,5... 1,5 Ω 6,4...11,1 k Ω 5,0... 9,0 k Ω
3	VOLTAGE SUPPLY, EI-K CONTROL UNIT Disconnect EI-K control-unit plug. Ignition ON. Voltage of EI-K control-unit plug. See upper illustration.	6 20 (+) (-)	Battery voltage
4	IGNITION-DISTRIBUTOR PLUG AND SOCKET Disconnect ignition-distributor plug. Visual check: Check ignition-distributor plug and socket for oxidation. See lower illustration.	—	—



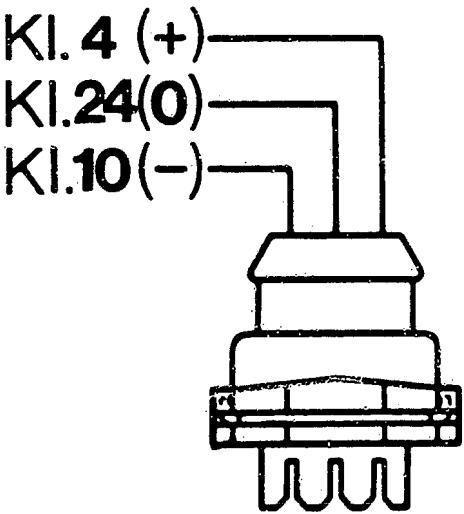
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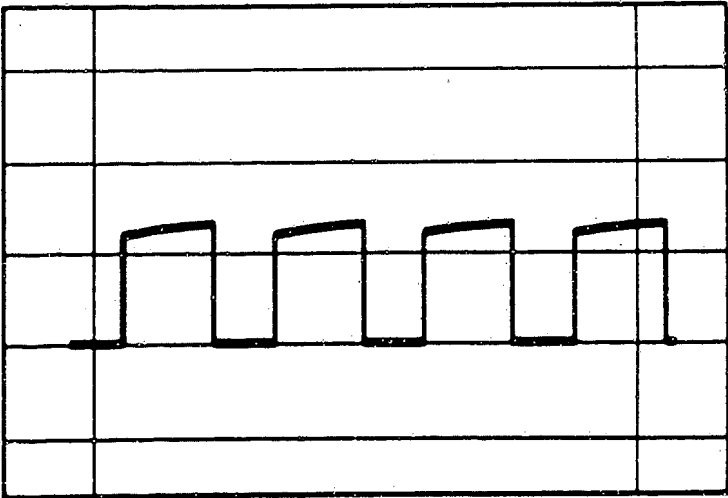
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RAPID DIAGNOSIS CHART (continued)

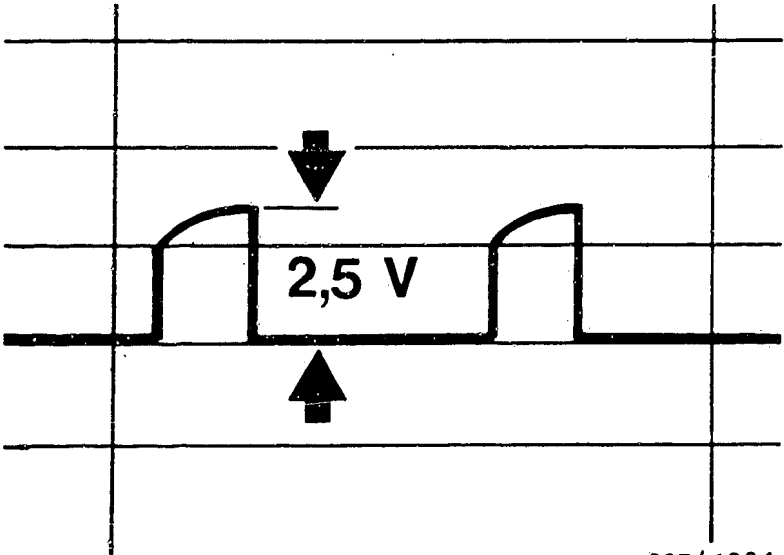
Test step	Testing of component/function Test instructions/conditions	Terminals	Set values
5	VOLTAGE SUPPLY, MAGNETIC PULSE GENERATOR Attach ignition-distributor and EI-K control-unit plug. Ignition ON. Voltage, ignition-distributor plug. See top picture.	4 10 (+) (-)	Equal to/greater than 10 V
6	MAGNETIC-PULSE-GENERATOR FUNCTION Start engine. Oscilloscope "special" to ignition-distributor plug. See top picture.	24 B- (+) (-)	Rectangular pulse (center picture)
7	EI-K CONTROL-UNIT FUNCTION Trigger-box, ignition-distributor and EI-K control-unit plug attached. Oscilloscope "special" to trigger-box plug. Start engine. * Note: The minimum voltage is important and not the profile (edges may be smooth)	2 B- (+) (-)	* Rectangular pulse equal to/greater than 2.5 V (bottom picture)
8	VOLTAGE SUPPLY, TRIGGER BOX Detach trigger-box plug. Ignition ON. Voltage, trigger-box plug.	1 3 (+) (-)	Battery voltage



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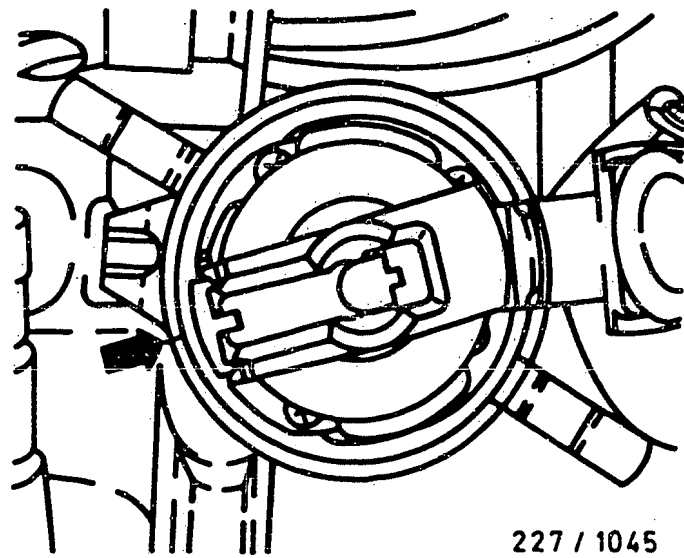
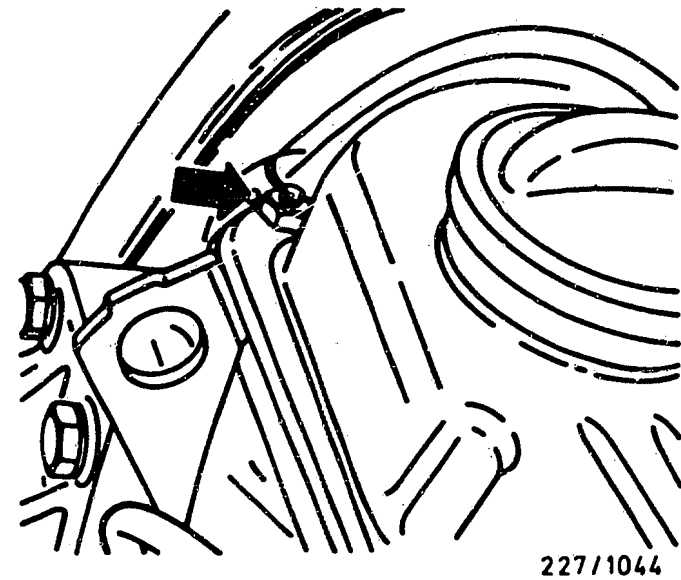
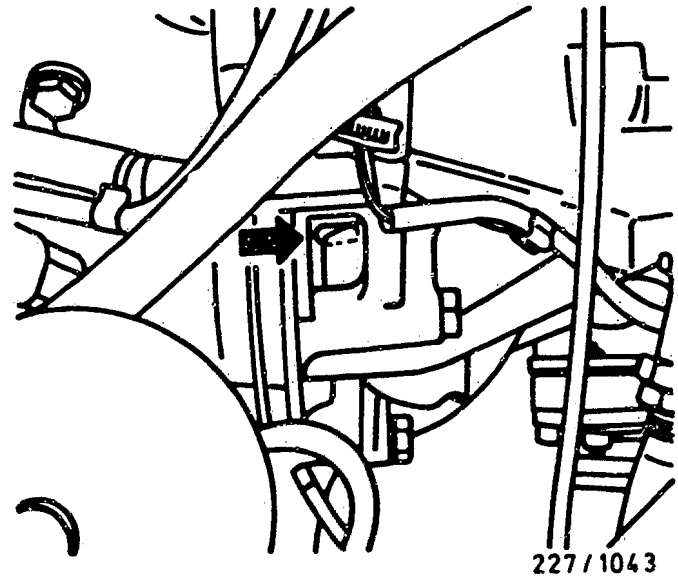


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RAPID DIAGNOSIS CHART (continued)

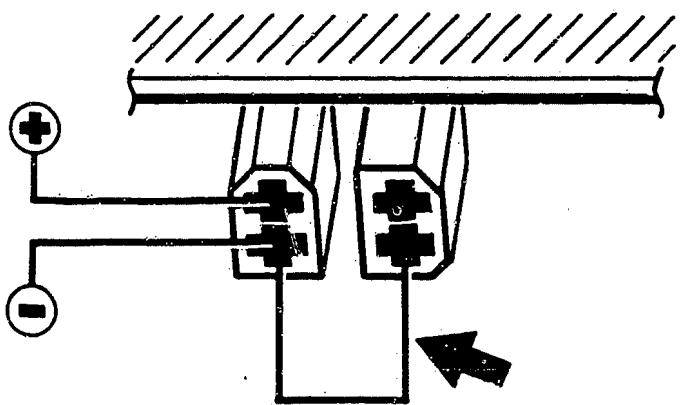
Test step	Testing of component/function Test instructions/conditions	Terminals	Set values
9	PRIMARY SIGNAL EI-K control-unit, trigger-box and ignition-distributor plug attached. Start engine. Oscilloscope/engine-speed tester to ignition coil.	15 (+) 1 (-)	Primary voltage/engine-speed indication (magnitude irrelevant)
10	ACTUATION OF ELECTRIC-FUEL-PUMP RELAY Ignition ON. Electric-fuel-pump relay including electric fuel pump is actuated. (audible).	—	Actuation approx. one second
11*	CONTACT RESISTANCES Check voltage supply leads of trigger box or primary circuit for contact resistance.	various	max.0,5 Ω
12*	IGNITION-DISTRIBUTOR AS-ASSEMBLED SETTING Engine cyl. 1 TDC. Top picture. Camshaft mark is in alignment with top edge of valve-cover gasket. Center picture. Center of distributor rotor points to mark on housing. Bottom picture.	—	—

* Perform only if engine does not run.



RAPID DIAGNOSIS CHART (continued)

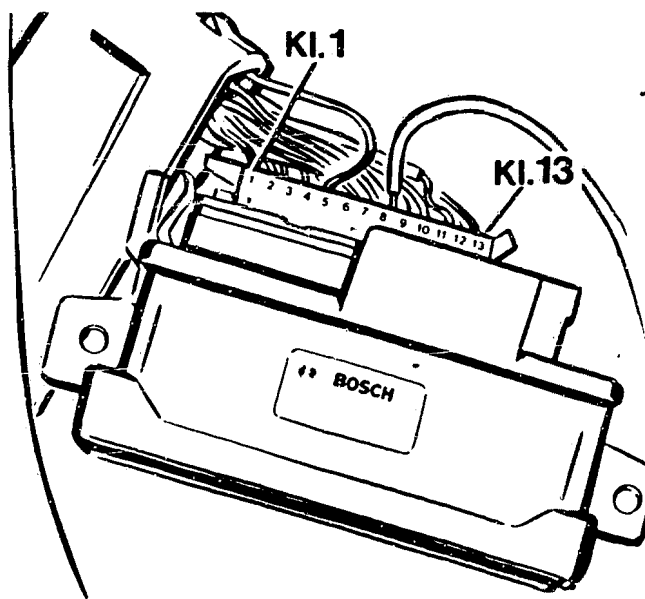
Test step	Testing of component/function Test instructions/conditions	Terminals	Set values
13	BASIC IGNITION SETTING Engine oil temperature min. 80° C Throttle-valve idle position. A/C switched off. Jumper diagnosis plug connection with measurement lead (until completion of test). See top picture, arrow. Engine idling. Note: setting $15 \pm 1^\circ$ BTDC See center picture, arrow.	—	13 - 17° BTDC
14	VOLTAGE SUPPLY, EI-K CONTROL UNIT Voltage, EI-K control-unit plug with handle cover removed. See bottom picture. Engine idling.	6 20 (+) (-)	12 - 14 V max. 2 V below U _B
15	VOLTAGE SUPPLY, IGNITION COIL Engine idling. Voltage, ignition coil and battery.	15 B- (+) (-)	Equal to/greater than 10 V



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TEST SPECIFICATIONS

Throttle-valve switch Idle with ignition ON in idle position	Approx. battery voltage
Feeler gauge 0,5...0,7 mm between throttle-valve stop	0 V
Throttle-valve switch - full-load Idle position	0 V
Open throttle valve 68...76° with ignition ON	Approx. battery voltage
Knock sensor Tightening torque	15...25 Nm
Altitude sensor Sea level	3,2...4,7 V
500 m	2,8...4,0 V
1000 m	2,4...3,5 V
1500 m	2,0...3,0 V
2000 m	1,5...2,5 V
3000 m	0,8...1,6 V
Load signal with engine idling	0,2...4,6 V

TEST SPECIFICATIONS (Continued)

Reference voltage for load and altitude sensors with ignition ON	4,5...5,1 V
Temperature sensor - coolant	+20°C 2,1...2,9k Ω +30°C 1,4...2,0k Ω +80°C 280...370 Ω +90°C 210...280 Ω +100°C 160...210 Ω
Ignition coil primary (Bosch)	0,6... 1,0 Ω
primary (non-Bosch)	0,5... 1,5 Ω
secondary (Bosch)	6,4...11,1 k Ω
secondary (non-Bosch)	5,0... 9,0 k Ω
Voltage supply, EI-K control unit with ignition ON	Battery voltage
Voltage supply, magnet pulse generator with ignition ON	Equals/above 10 V
Magnet pulse generator functioning at cranking speed	Rectangular pulse

TEST SPECIFICATIONS (continued)

EI-K control-unit function at cranking speed	Rectangular pulse
--	-------------------

Voltage supply, trigger box with ignition ON	Battery voltage
--	-----------------

Primary signal at cranking speed	Primary voltage/ engine-speed indication
-------------------------------------	--

Actuation of electric- fuel-pump relay with ignition ON	approx. 1 second (audible)
---	-------------------------------

Contact resistance	max.0,5 Ω
--------------------	------------------

Supply leads, trigger
box/primary
circuit

Ignition-distributor as-assembled setting	Cyl.1 TDC ID mark
--	----------------------

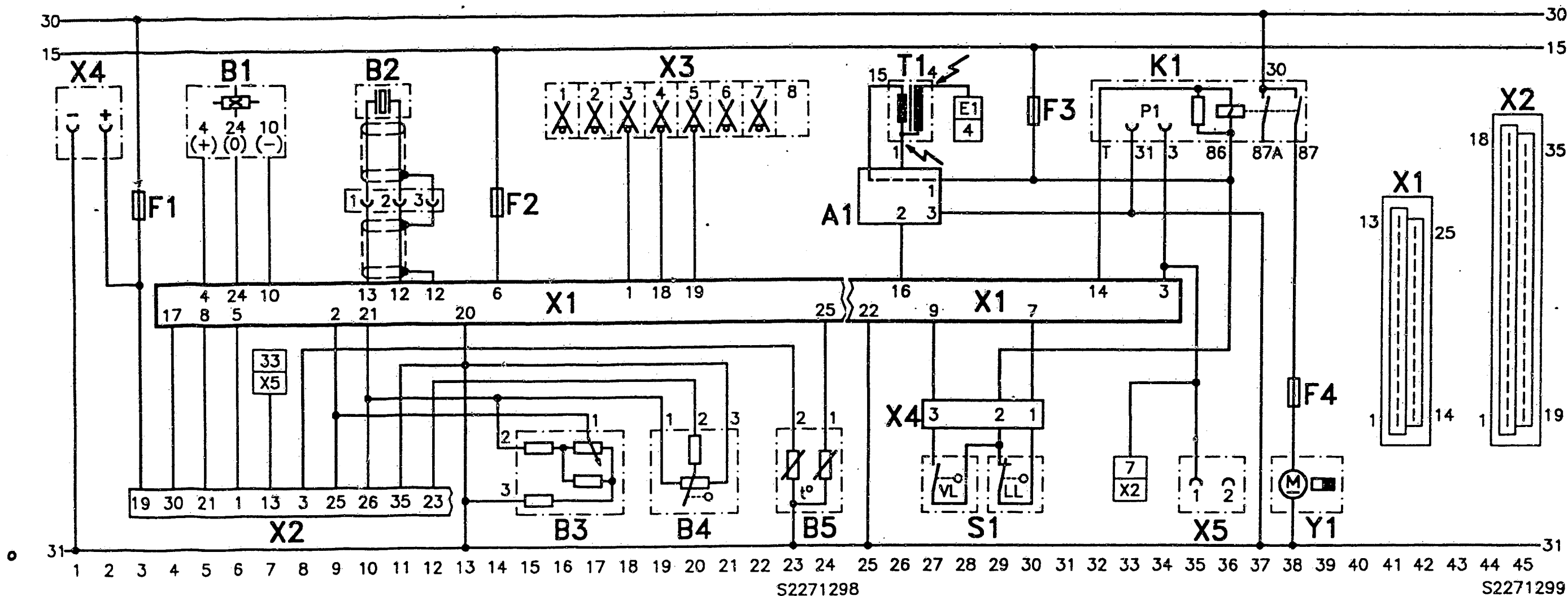
Basic ignition setting Diagnosis plug connection jumped Engine idling	13...17° BTDC (Setting 15 \pm 1° BTDC)
--	--

TEST SPECIFICATIONS (continued)

Voltage supply EI-K control unit Engine idling	12...14 V max.2 V below U _B
--	---

Voltage supply Ignition coil Engine idling	equal to/ greater than 10 V
--	--------------------------------

Refer to SIS microcard "Jetronic" or
Autodata test specifications as regards
settings for idle speed, exhaust emissions,
valve clearance etc.

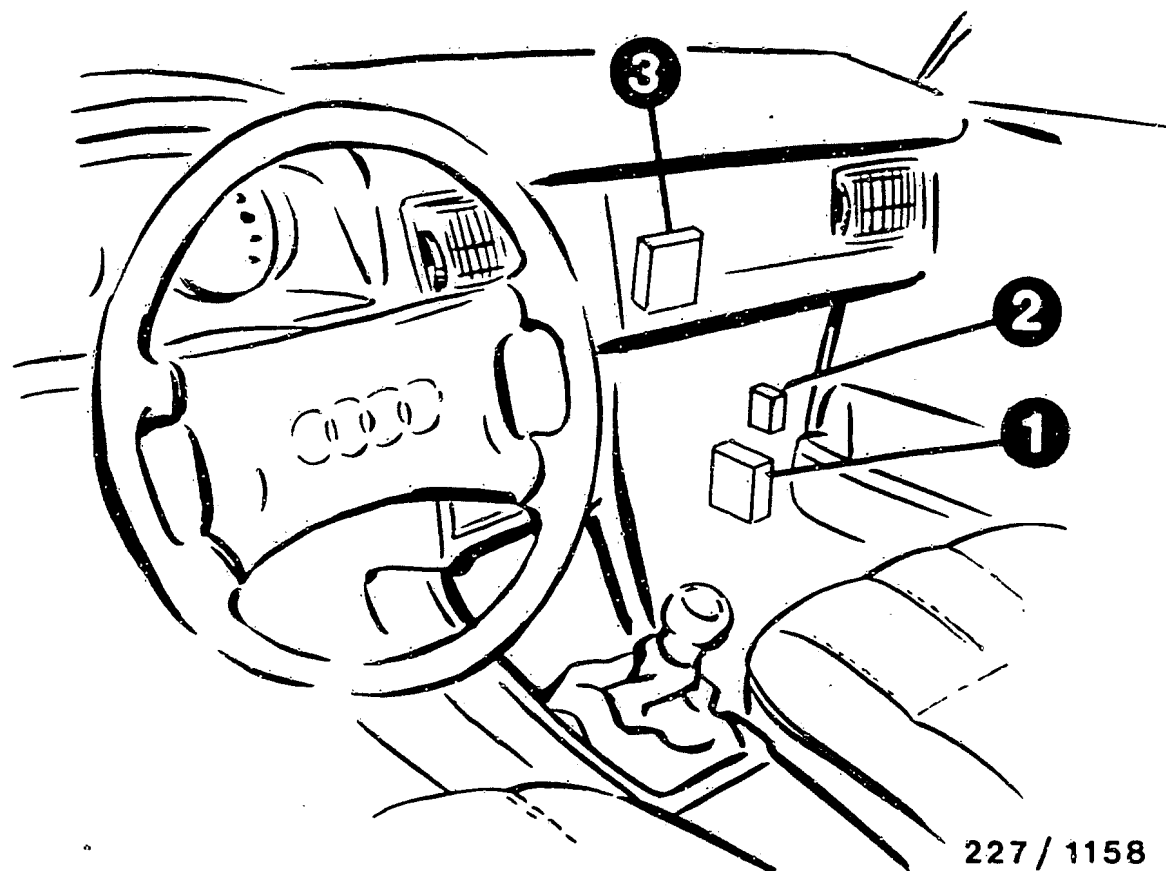


ELECTRICAL TERMINAL DIAGRAM

High-tension arrows: caution 400 V...25 kV

A1 = Trigger box	F1...4 = Fuses
B1 = Magnetic pulse generator	K1 = Electric-fuel-pump relay
B2 = Knock sensor	P1 = Contacts (previously diagnosis)
B3 = Altitude sensor	S1 = Throttle-valve switch idle/full load
B4 = Air-flow sensor (potentiometer)	T1 = Ignition coil
B5 = Temperature sensor (coolant)	X1 = EI-K control-unit plug
E1 = to ignition distributor	X2 = KE-Jetronic control-unit plug

X3 = Encoding plug
 X4 = Diagnosis plug connection
 X5 = Diagnosis plug connection (stimulation lead)
 Y1 = Electric fuel pump

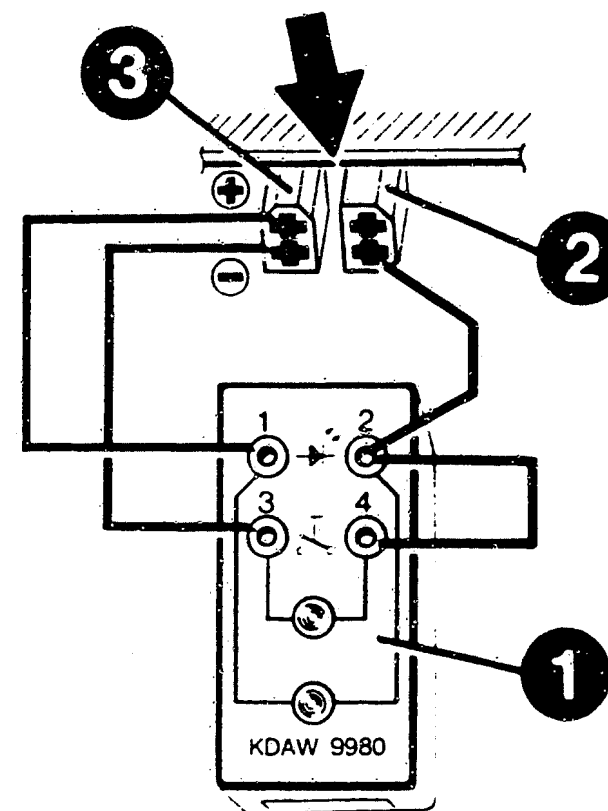


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- 1 = EI-K control unit
- 2 = Altitude sensor
- 3 = KE-Jetronic control unit

INSTALLATION POSITION OF COMPONENTS

- * EI-K control unit:
In passenger-side footwell (see picture).
- * Altitude sensor:
In passenger-side footwell above EI-K control unit (see picture).
- * KE-Jetronic control unit:
In passenger-side footwell (see picture).
- * Variant encoding (if provided):
On EI-K control unit.
- * Temperature sensor (coolant):
Next to spark plug, cylinder 1
- * Throttle-valve switch (idle/full load):
On throttle-valve assembly
- * Trigger box with ignition coil:
Next to battery.
- * Knock sensor:
In vicinity of left-hand engine mount.
- * Electric-fuel-pump relay:
In central-electrics console.



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- 1 = Evaluation unit KDAW 9980
- 2 = Diagnosis plug connection (* brown)
- 3 = Diagnosis plug connection (* black)

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

Diagnosis plug connections are located in the footwell (driver's side) in the recess behind the tray.

* The colour may change.

Trouble-shooting instructions: AUD-5018

BOSCH system : EI-K

Vehicle make : Audi

Basic microcard : PKW-051

TABLE OF CONTENTS

Section	Coordinates
Special features, use, safety	02
Trouble-shooting chart	05
Self-diagnosis test table	07
Rapid diagnosis chart	13
Test specifications	21
Electrical terminal diagram	25
Installation position of components, instructions for removal and installation	27

SPECIAL FEATURES

These brief instructions, valid at the time of publication, apply to the following

Audi Model:

Audi 100, 100 quattro, 2.3 E

Engine 2.3 l, 5 cyl. 100 kW code letters NF
9.88 ->

- * EI-K control unit 0 227 400 134
EI-K control unit 0 227 400 165 4.89 ->
- * Ignition coil with trigger box 0 221 600 050
- * Ignition coil without trigger box 0 221 122 358
- * Variant encoding
- * Activate self-diagnosis as follows:
As of model year 1989 there is no activation of the self-diagnosis via the electric-fuel-pump relay or evaluation of the flashing code via the fault lamp in the instrument cluster.
Activation/evaluation of the flashing code is effected with the EVALUATION UNIT KDAW 9980 via 2 diagnosis plug connections located in the footwell (driver's side). The self-diagnosis sequence is the same as that indicated in the basic instructions.
The evaluation-unit button is pressed instead of "bridge electric-fuel-pump relay".
Refer to INSTALLATION POSITION OF COMPONENTS for connecting evaluation unit to diagnosis plug connections.

Test prerequisites:

Fuses 13, 21, 28 O.K. Intake-manifold
ground connection O.K.

- * Trouble-shooting and fault elimination for test step MAGNETIC-PULSE-GENERATOR FUNCTION are to be performed as follows:
1. Detach ignition-distributor plug and EI-K control-unit plug and check lead term. 24 for open circuit, short to ground or short to positive. Eliminate fault.

SPECIAL FEATURES (CONTINUED)

2. Attach EI-K control-unit plug.
Connect voltmeter to ignition-distributor
plug term. 24 (+) and vehicle ground (-).

N o t e:

Use voltmeter with internal resistance
(Ri) greater than 50 k Ω /V (otherwise
incorrect measurement).

Ignition ON.

Set value: equal to/greater than 2 V

Renew EI-K control unit if set value
was not attained.

Renew magnetic pulse generator or
ignition distributor if items 1 and 2 O.K.

* Perform trouble-shooting and fault elimination
for test step EI-K CONTROL-UNIT FUNCTION as
follows:

If set value (rectangular pulse at least 2.5 V)
was not attained, check lead from EI-K control
unit term. 16 to trigger-box plug term. 2 for
open circuit or short to ground.

Eliminate open circuit, short to ground.

Attach EI-K control-unit plug.

Detach trigger-box plug and connect resistance
of 240...270 Ω (e.g. commercially available
decade resistor) to term. 2 and term. 3.

Connect oscilloscope "special" with red terminal
to trigger-box plug term. 2 (+).

Black terminal to vehicle ground (-).

Start engine.

Oscilloscope must indicate a rectangular pulse
of at least 2.5 V.

Renew trigger box if set value attained.
Renew EI-K control unit if set value not
attained.

STRUCTURE AND USAGE

These brief instructions encompass essentially
vehicle-specific special features and test
specifications (set values).

In accordance with the customer complaint,
the trouble-shooting chart leads to different
causes/component faults.
For a detailed description of trouble-shooting,
see the information in the trouble-shooting
chart of the basic instructions.

ATTENTION: Even if reference is made to
basic instructions, the set values, terminal
assignments and special features of these
vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to
avoid damage to the engine, trigger boxes and
control units or to the ignition system,
observe the information in the basic instructions.

CAUTION!

High-performance ignition system with
dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals
may prove fatal (both on the primary and
secondary sides).

TROUBLE-SHOOTING CHART

Customer complaint (symptoms of trouble)

- Starting motor operates, engine fails to start or starts only with difficulty
- Engine starts but then dies
- Idle problems (engine speed, exhaust)
- Poor throttle response.
- Engine missing (ignition, injection)
- Insufficient maximum power/speed
- Excessive fuel consumption
- Engine diesels
- Engine pings/knocks
- Engine overheats
- Fault lamp.

Cause (component fault)										
*	*	*	*	*	*	*	*	*	*	Self-diagnosis
*			*							High-voltage side
*			*							Ignition coil
*										Firing sequence
*										Voltage - EI-K control unit
*										Ignition-distributor plug and socket
*										Voltage, magnetic pulse generator
*										Function, magnetic pulse generator
*										EI-K control units, function
*										Voltage, trigger box
*										Primary signal
*										Triggering, electric fuel pump relay

TROUBLE-SHOOTING CHART (Continued)

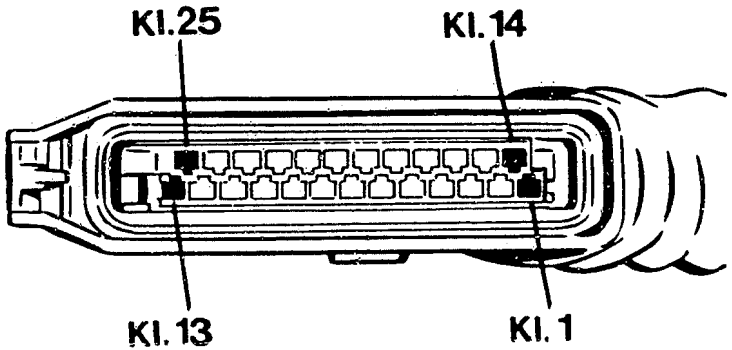
Customer complaint (fault symptoms)

- Starting motor operates, engine fails to start or starts only with difficulty.
- Engine starts but then dies.
- Idle problems (Engine speed, exhaust gas).
- Poor throttle take-up, flat spot during acceleration.
- Engine missing (ignition, injection).
- Maximum engine power/top speed not reached.
- Fuel consumption too high.
- Engine running on (dieseling).
- Engine pinging/knocking.
- Engine overheating.
- Fault lamp.

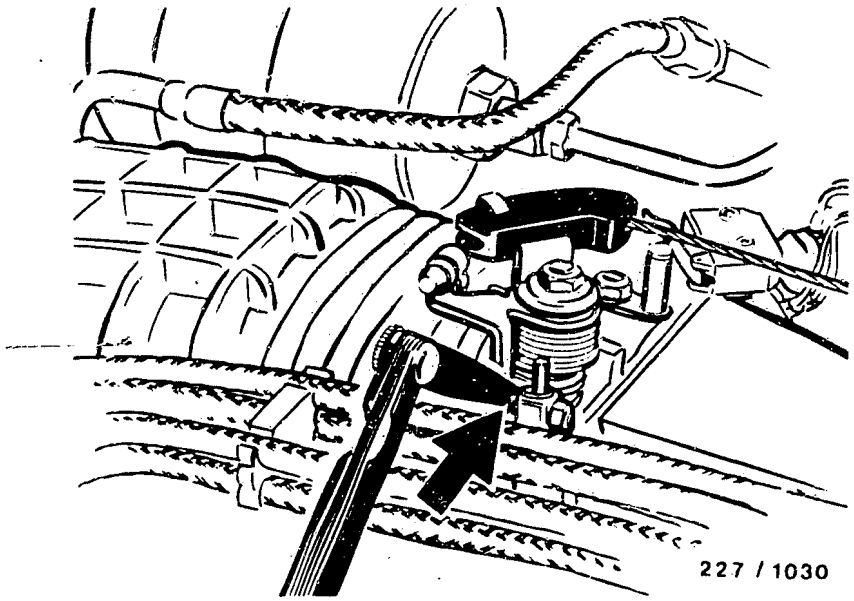
Cause (component fault)										
*										Contact resistance
*										Ignition-distributor as-assembled setting
*				*	*		*	*	*	Basic ignition setting
			*							Voltage, EI-K control unit
			*							Voltage, ignition coil

SELF-DIAGNOSIS TEST TABLE

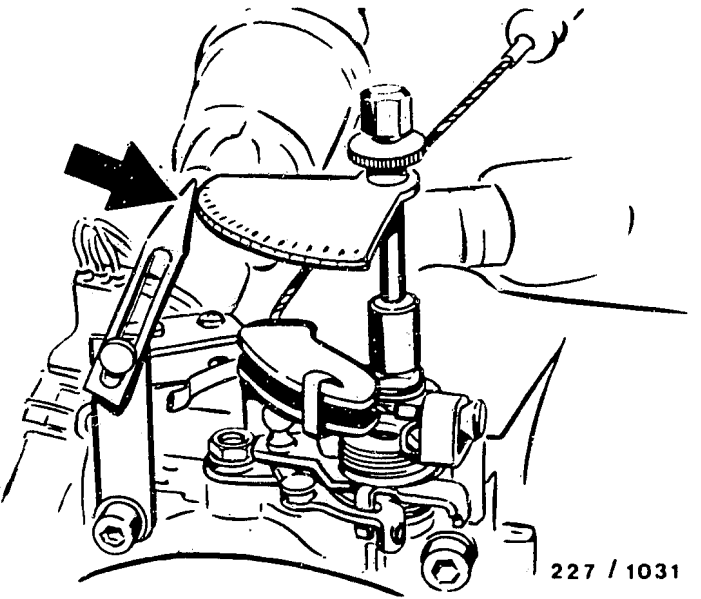
Fault display Flash code	Testing of component/function Test instructions/conditions	Term.	Set values
1 1 1 1	EI-K CONTROL UNIT Replace EI-K control unit.	—	—
2 1 2 1	THROTTLE-VALVE SWITCH - IDLE Voltage, EI-K control-unit plug. Upper illustration. Throttle valve in idle position. Ignition ON. Feeler gauge 0,5...0,7 mm between throttle-valve stop and adjusting screw. See center illustration, arrow.	7 20 (+) (-)	approx. battery voltage 0 V
2 1 2 3	THROTTLE-VALVE SWITCH - FULL LOAD Voltage, EI-K control-unit plug. Throttle valve in idle position. Ignition ON. Graduated disc on throttle valve level 1. See lower illustration, arrow. 68...76° after idle position.	9 20 (+) (-)	0 V approx. battery voltage.



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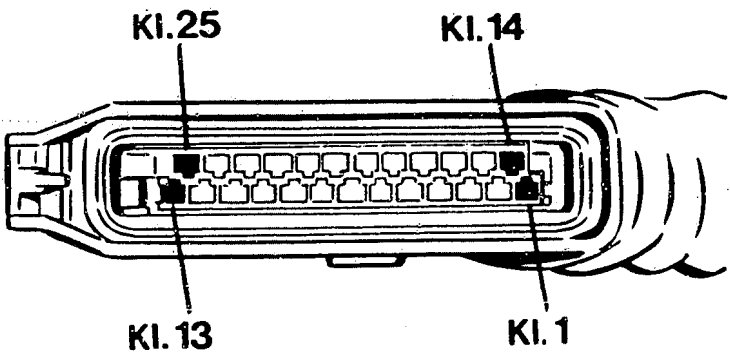
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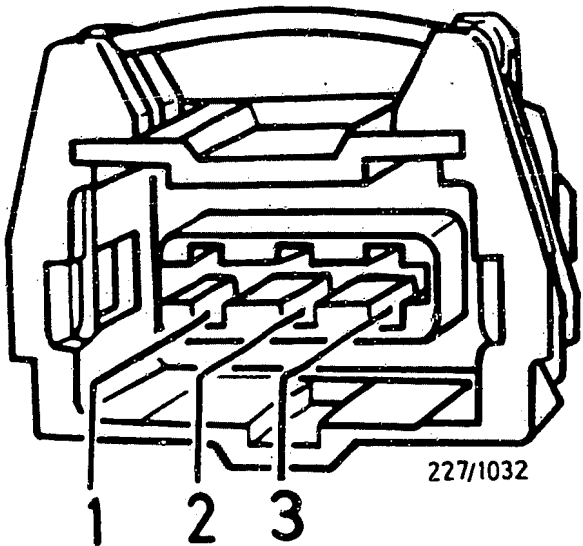
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SELF-DIAGNOSIS TEST TABLE (Continued)

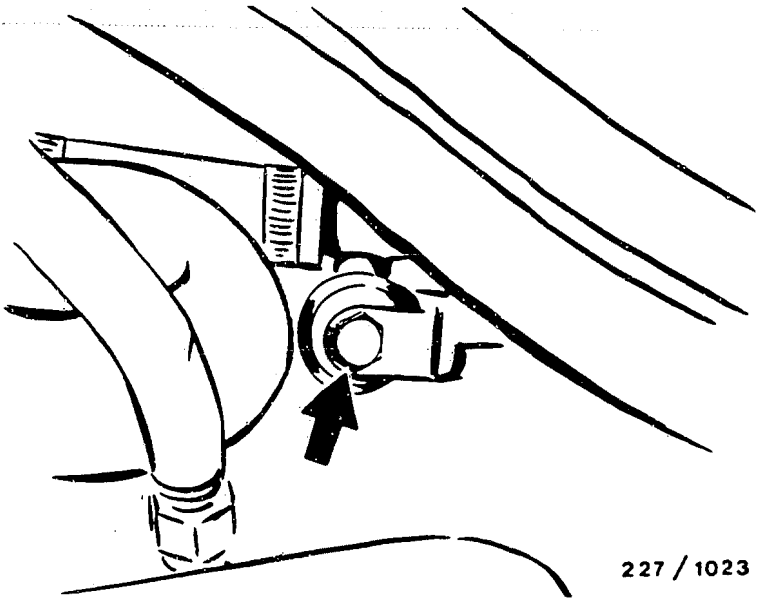
Fault display Flash code	Testing of component/function Test instructions/conditions	Term.	Set values
2 1 4 1	MAXIMUM RETARDATION OF KNOCK CONTROL Fuel with insufficient octane number, Check ignition-point adjustment, fuel- injection. Bearing damage, abnormal engine noises.	—	—
2 1 4 2	KNOCK SENSOR Resistance of EI-K control-unit plug (upper illustration) and knock-sensor plug connection (center illustration). Resistance of knock-sensor plug connec. See center illustration. Tightening torque. See lower ill., arrow.	<div>13 1</div> <div>12 2</div> <div>12 3</div> <div>1 2</div>	<div>approx. 0 Ω</div> <div>approx. 0 Ω</div> <div>approx. 0 Ω</div> <div>infinite Ω</div> 15–25 Nm
2 2 2 3	ALTITUDE SENSOR Voltage of EI-K control-unit plug. See upper illustration. Ignition ON.	<div>2 20</div> <div>(+) (–)</div>	<div>Sea level = 3,2...4,7V</div> <div>500 m = 2,8...4,0V</div> <div>1000m = 2,4...3,5V</div> <div>1500m = 2,0...3,0V</div> <div>2000m = 1,5...2,5V</div> <div>3000m = 0,8...1,6V</div>



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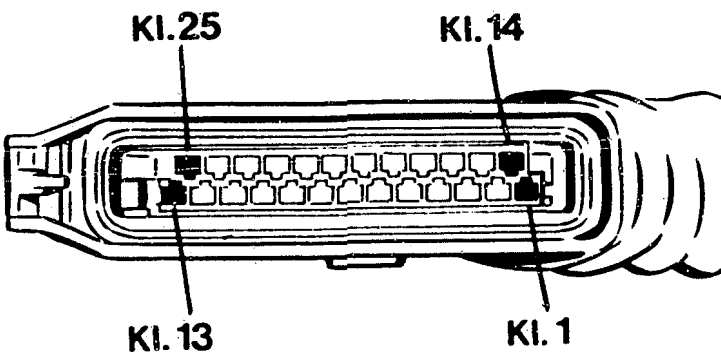
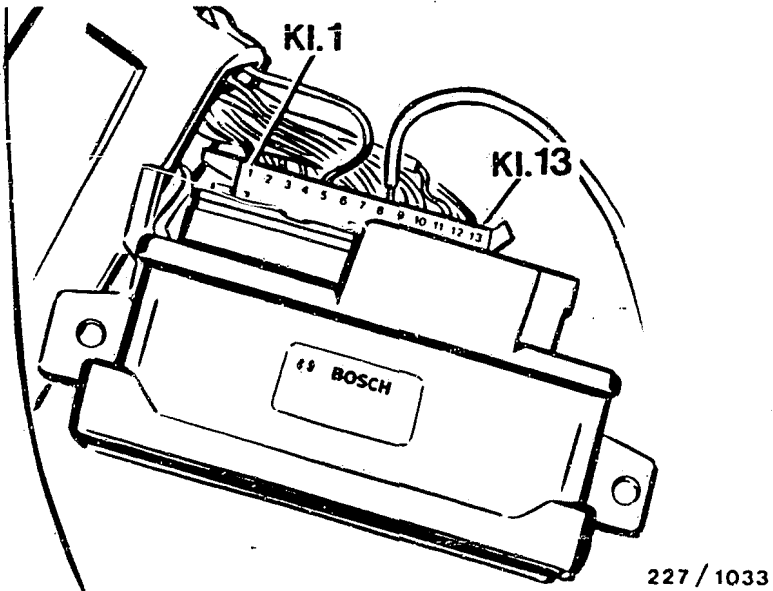
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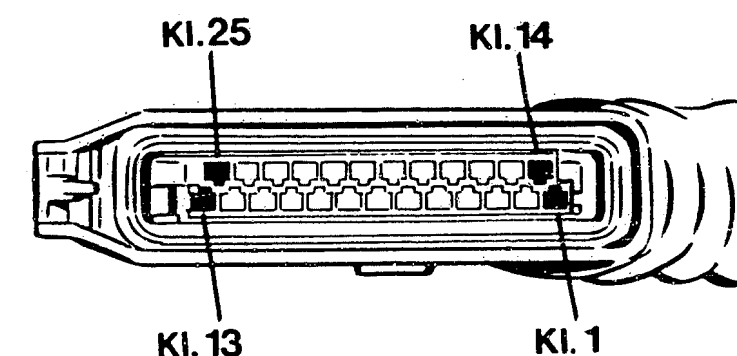
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SELF-DIAGNOSIS TEST TABLE (Continued)

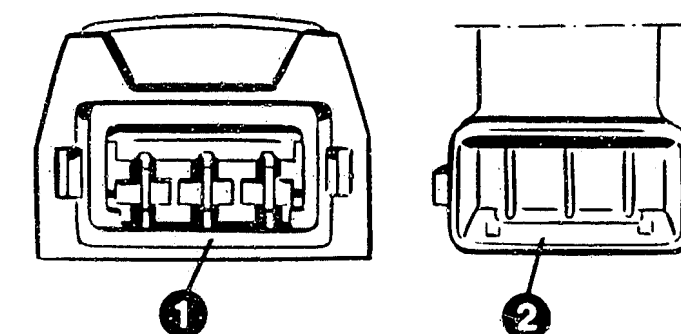
Fault display Flash code	Testing of component/function Test instructions/conditions	Term.	Set values
2 2 3 2	LOAD SIGNAL Voltage, EI-K control-unit plug with handle cover removed. See upper illustration. Engine at idle.	8 20 (+) (-)	0,2...4,6 V
2 2 3 3	REFERENCE VOLTAGE FOR LOAD- AND ALTITUDE-SENSOR SIGNAL Voltage, EI-K control-unit plug. See lower illustration. Ignition ON.	21 20 (+) (-)	4,5...5,1 V
2 3 1 2	TEMPERATURE SENSOR - COOLANT Resistance of EI-K control-unit plug. See lower illustration.	25 20	+ 20°C=2,1...2,9k Ω + 30°C=1,4...2,0k Ω + 80°C=280...370 Ω + 90°C=210...280 Ω +100°C=160...210 Ω
4 4 4 4	NO FAULT IN MEMORY	—	—
0 0 0 0	END OF FAULT OUTPUT	—	—



Test step	Testing of component/function Test instructions/conditions	Term.	Set values
1	HIGH-VOLTAGE SIDE For example, check spark plugs, ignition harness, distributor cap, etc. for proper operation (e.g. open circuits, shunt). Evaluate with ignition oscillogram, resistance measurement, visual check for example.	—	—
2	IGNITION COIL Visual check (Bosch only): Are seal plugs present, has sealing compound escaped? Primary resistance (Bosch) Secondary resistance (non-Bosch) Primary resistance (Bosch) Secondary resistance (non-Bosch)	— 1 15 1 15 1 4 1 4	— 0,6... 1,0 Ω 0,5... 1,5 Ω 6,4...11,1 k Ω 5,0... 9,0 k Ω
3	VOLTAGE SUPPLY, EI-K CONTROL UNIT Disconnect EI-K control-unit plug. Ignition ON. Voltage of EI-K control-unit plug. See upper illustration.	6 20 (+) (-)	Battery voltage
4	IGNITION-DISTRIBUTOR PLUG AND SOCKET Disconnect ignition-distributor plug. Visual check: Check ignition-distributor plug and socket for oxidation. See lower illustration.	—	—



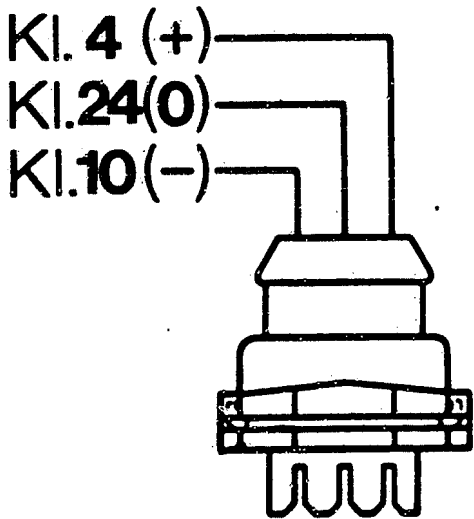
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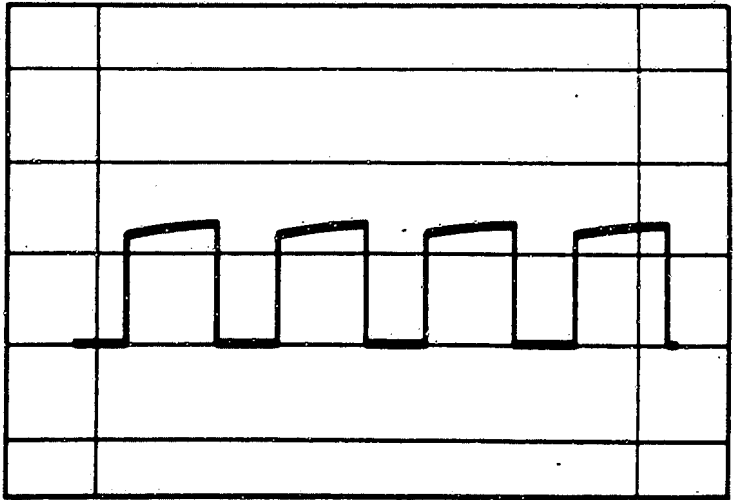
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RAPID DIAGNOSIS CHART (continued)

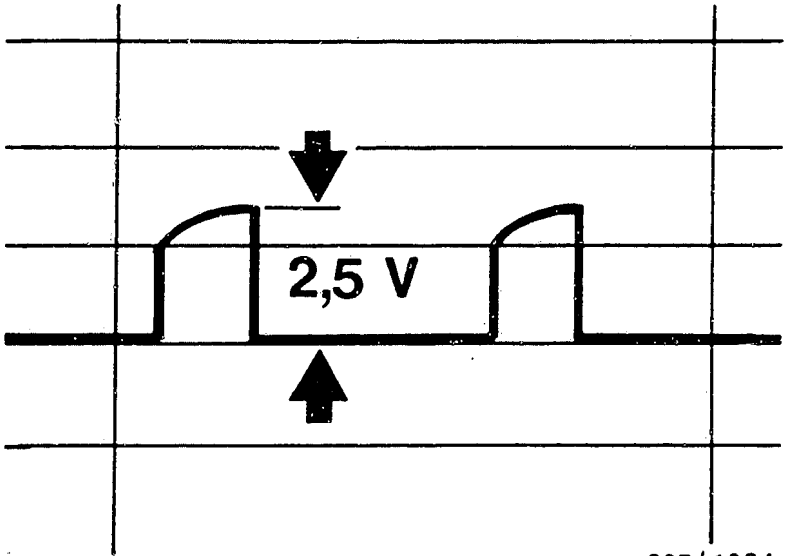
Test step	Testing of component/function Test instructions/conditions	Terminals	Set values
5	VOLTAGE SUPPLY, MAGNETIC PULSE GENERATOR Attach ignition-distributor and EI-K control-unit plug. Ignition ON. Voltage, ignition-distributor plug. See top picture.	4 10 (+) (-)	Equal to/greater than 10 V
6	MAGNETIC-PULSE-GENERATOR FUNCTION Start engine. Oscilloscope "special" to ignition-distributor plug. See top picture.	24 B- (+) (-)	Rectangular pulse (center picture)
7	EI-K CONTROL-UNIT FUNCTION Trigger-box, ignition-distributor and EI-K control-unit plug attached. Oscilloscope "special" to trigger-box plug. Start engine. * Note: The minimum voltage is important and not the profile (edges may be smooth)	2 B- (+) (-)	* Rectangular pulse equal to/greater than 2.5 V (bottom picture)
8	VOLTAGE SUPPLY, TRIGGER BOX Detach trigger-box plug. Ignition ON. Voltage, trigger-box plug.	1 3 (+) (-)	Battery voltage



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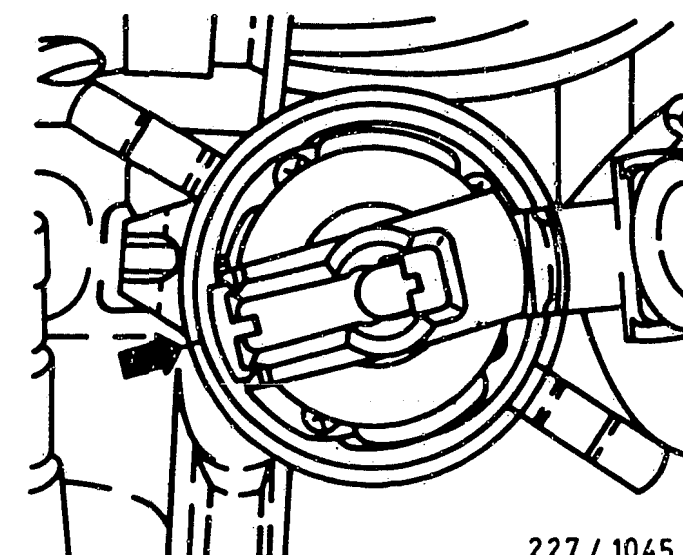
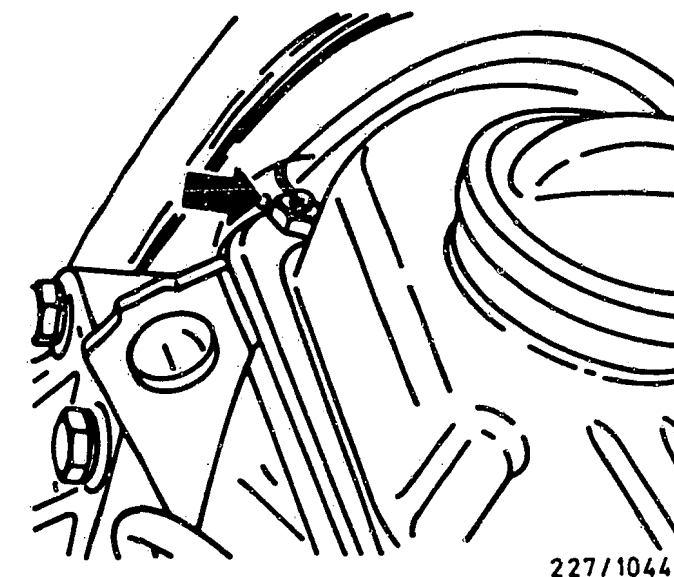
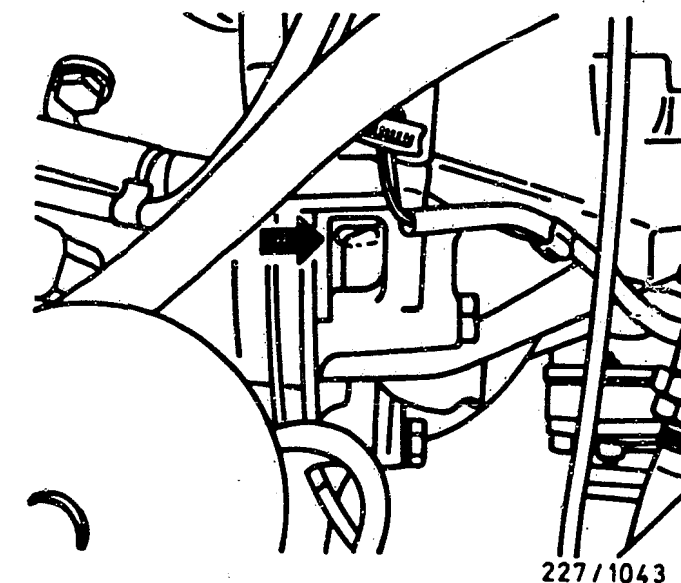


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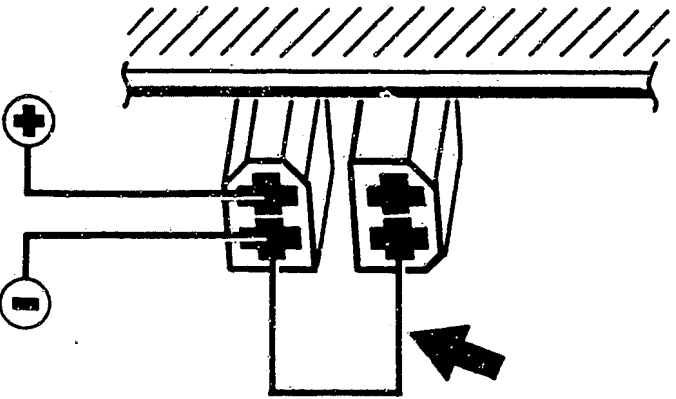
RAPID DIAGNOSIS CHART (continued)

Test step	Testing of component/function Test instructions/conditions	Terminals	Set values
9	PRIMARY SIGNAL EI-K control-unit, trigger-box and ignition-distributor plug attached. Start engine. Oscilloscope/engine-speed tester to ignition coil.	15 (+) 1 (-)	Primary voltage/engine-speed indication (magnitude irrelevant)
10	ACTUATION OF ELECTRIC-FUEL-PUMP RELAY Ignition ON. Electric-fuel-pump relay including electric fuel pump is actuated. (audible).	—	Actuation approx. one second
11*	CONTACT RESISTANCES Check voltage supply leads of trigger box or primary circuit for contact resistance.	various	max. 0,5 Ω
12*	IGNITION-DISTRIBUTOR AS-ASSEMBLED SETTING Engine cyl. 1 TDC. Top picture. Camshaft mark is in alignment with top edge of valve-cover gasket. Center picture. Center of distributor rotor points to mark on housing. Bottom picture.	—	—

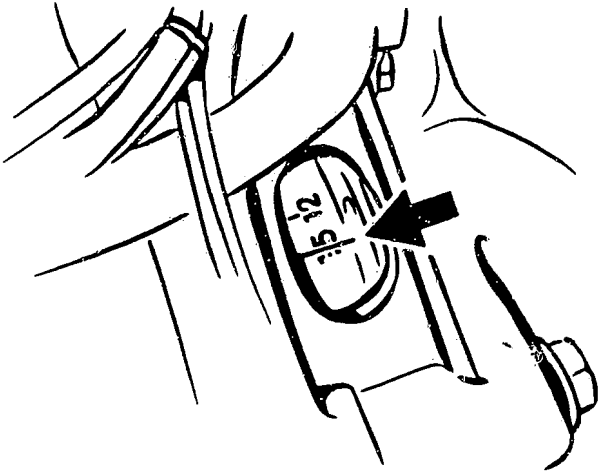
* Perform only if engine does not run.



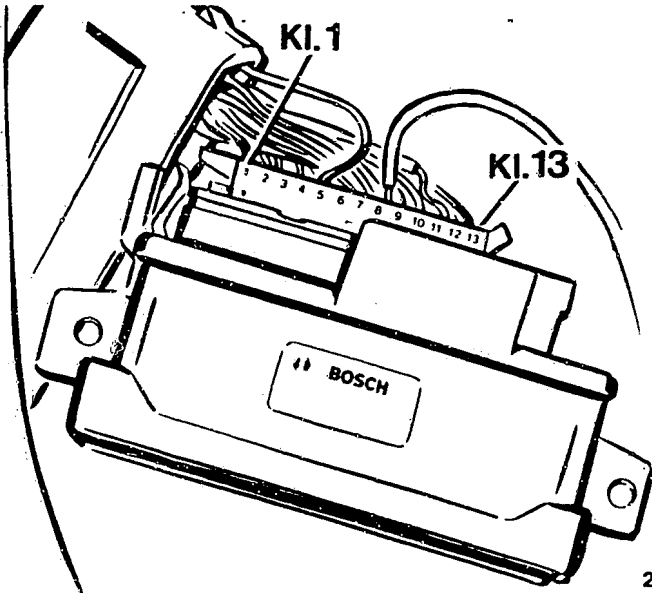
Test step	Testing of component/function Test instructions/conditions	Terminals	Set values
13	BASIC IGNITION SETTING Engine oil temperature min. 80° C Throttle-valve idle position. A/C switched off. Jumper diagnosis plug connection with measurement lead (until completion of test). See top picture, arrow. Engine idling. Note: setting $15 \pm 1^\circ$ BTDC See center picture, arrow.	—	13 - 17° BTDC
14	VOLTAGE SUPPLY, EI-K CONTROL UNIT Voltage, EI-K control-unit plug with handle cover removed. See bottom picture. Engine idling.	6 20 (+) (-)	12 - 14 V max. 2 V below U _B
15	VOLTAGE SUPPLY, IGNITION COIL Engine idling. Voltage, ignition coil and battery.	15 B- (+) (-)	Equal to/greater than 10 V



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TEST SPECIFICATIONS

Throttle-valve switch Idle with ignition ON in idle position	Approx. battery voltage
---	-------------------------

Feeler gauge 0,5...0,7 mm between throttle-valve stop	0 V
---	-----

Throttle-valve switch - full-load Idle position	0 V
Open throttle valve 68...76° with ignition ON	Approx. battery voltage

Knock sensor Tightening torque	15...25 Nm
-----------------------------------	------------

Altitude sensor Sea level	3,2...4,7 V
500 m	2,8...4,0 V
1000 m	2,4...3,5 V
1500 m	2,0...3,0 V
2000 m	1,5...2,5 V
3000 m	0,8...1,6 V

Load signal with engine idling	0,2...4,6 V
-----------------------------------	-------------

TEST SPECIFICATIONS (Continued)

Reference voltage for load and altitude sensors with ignition ON	4,5...5,1 V
--	-------------

Temperature sensor - coolant	+20°C 2,1...2,9k Ω
	+30°C 1,4...2,0k Ω
	+80°C 280...370 Ω
	+90°C 210...280 Ω
	+100°C 160...210 Ω

Ignition coil primary (Bosch)	0,6... 1,0 Ω .
primary (non-Bosch)	0,5... 1,5 Ω
secondary (Bosch)	6,4...11,1 k Ω
secondary (non-Bosch)	5,0... 9,0 k Ω

Voltage supply, EI-K control unit with ignition ON	Battery voltage
--	-----------------

Voltage supply, magnet pulse generator with ignition ON	Equals/above 10 V
---	-------------------

Magnet pulse generator functioning at cranking speed	Rectangular pulse
--	-------------------

TEST SPECIFICATIONS (continued)

EI-K control-unit function at cranking speed	Rectangular pulse
--	-------------------

Voltage supply, trigger box with ignition ON	Battery voltage
--	-----------------

Primary signal at cranking speed	Primary voltage/ engine-speed indication
-------------------------------------	--

Actuation of electric- fuel-pump relay with ignition ON	approx. 1 second (audible)
---	-------------------------------

Contact resistance	max. 0,5 Ω
--------------------	-------------------

Supply leads, trigger
box/primary
circuit

Ignition-distributor as-assembled setting	Cyl. 1 TDC ID mark
--	-----------------------

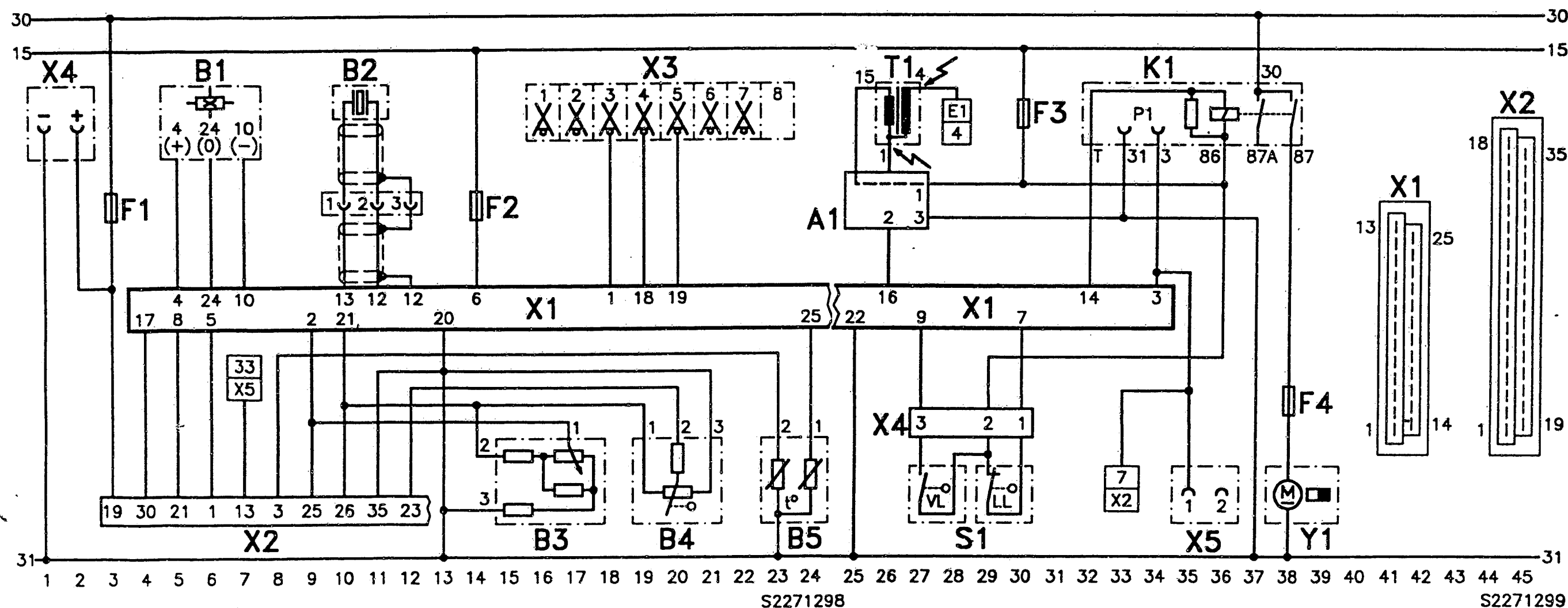
Basic ignition setting Diagnosis plug connection jumped Engine idling	13...17° BTDC (Setting 15 \pm 1° BTDC)
--	--

TEST SPECIFICATIONS (continued)

Voltage supply EI-K control unit Engine idling	12...14 V max. 2 V below U _B
--	--

Voltage supply Ignition coil Engine idling	equal to/ greater than 10 V
--	--------------------------------

Refer to SIS microcard "Jetronic" or
Autodata test specifications as regards
settings for idle speed, exhaust emissions,
valve clearance etc.



ELECTRICAL TERMINAL DIAGRAM

High-tension arrows: caution 400 V...25 kV

- | | | |
|--------------------------------------|---|---|
| A1 = Trigger box | F1...4 = Fuses | X3 = Encoding plug |
| B1 = Magnetic pulse generator | K1 = Electric-fuel-pump relay | X4 = Diagnosis plug connection |
| B2 = Knock sensor | P1 = Contacts (previously diagnosis) | X5 = Diagnosis plug connection (stimulation lead) |
| B3 = Altitude sensor | S1 = Throttle-valve switch idle/full load | Y1 = Electric fuel pump |
| B4 = Air-flow sensor (potentiometer) | T1 = Ignition coil | |
| B5 = Temperature sensor (coolant) | X1 = EI-K control-unit plug | |
| E1 = to ignition distributor | X2 = KE-Jetronic control-unit plug | |

INSTALLATION POSITION OF COMPONENTS

EI-K control unit:
In driver's footwell.

Altitude sensor:
In driver's footwell above EI-K control unit.

KE-Jetronic control unit:
In passenger-side footwell.

Variant encoding:
In passenger-side footwell in plastic sheath
next to KE-Jetronic control unit.

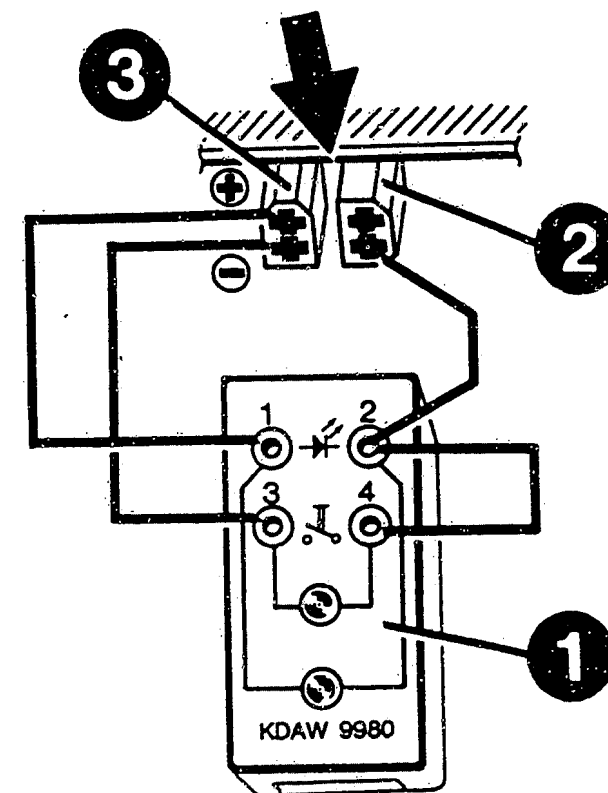
Temperature sensor (coolant):
Next to spark plug, cylinder 1.

Throttle-valve switch, idle/full load:
On throttle-valve assembly.

Trigger box with ignition coil:
Next to windscreen-washer reservoir.

Knock sensor:
In vicinity of left-hand engine mount.

Electric-fuel-pump relay:
In central-electrics console.



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- 1 = Evaluation unit KDAW 9980
- 2 = Diagnosis plug connection (* brown)
- 3 = Diagnosis plug connection (* black)

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

Diagnosis plug connections are located in the footwell
(driver's side) at the front on the heating duct.

* Color may change.

Trouble-shooting instructions: AUD-5019

BOSCH system : EI-K

Vehicle make : Audi

Basic microcard : PKW-051

TABLE OF CONTENTS

Section	Coordinates
Special features, use, safety	02
Trouble-shooting chart	07
Self-diagnosis test table	09
Rapid diagnosis chart	15
Test specifications	23
Electrical terminal diagram	25
Installation position of components, instructions for removal and installation	27

SPECIAL FEATURES

These brief instructions, valid at the time of publication, apply to the following Audi model:
Audi 100, 100 quattro, 2.3 E , USA-Cal.
Engine 2.3 l, 5 cyl. 100 kW code letters NF
9.88 ->

- * EI-K control unit 0 227 400 136
EI-K control unit 0 227 400 167,...160
4.89 ->
- * Ignition coil with trigger box 0 221 600 050
- * Ignition coil without trigger box 0 221 122 358
- * Variant encoding
- * Self-diagnosis:
As of model year 1989 there is no activation of the self-diagnosis by way of the electric-fuel-pump relay or evaluation of the flashing code by way of a fault lamp in the instrument cluster.
Activation/evaluation of the flashing code is effected with the EVALUATION UNIT KDAW 9980 via 2 diagnosis plug connections located in the footwell (driver's side).
The evaluation-unit button is pressed instead of "bridge electric-fuel-pump relay".
Refer to INSTALLATION POSITION OF COMPONENTS for connection of evaluation unit to diagnosis plug connections.

The KE-Jetronic control unit is equipped with a permanent memory. EI-K control-unit faults are also stored in this memory. Fault output is effected separately according to EI-K and KE-Jetronic.

Test prerequisites:
Fuses 13, 21, 28 O.K. Intake-manifold ground connection O.K.

SPECIAL FEATURES (CONTINUED)

The following test sequence must be complied with:

Activating EI-K

(With fault memory cleared perform test drive for at least 5 minutes on road/roller dynamometer at engine speed in excess of 3000 min⁻¹. In doing so, briefly depress accelerator pedal as far as it will go. Or if engine won't go, actuate starting motor for approx. 6 seconds).

Ignition OFF. Ignition ON. Press button of evaluation unit KDAW 9980 for at least 4 seconds. Note down flashing code. Continue pressing button until flashing code 0 0 0 0 (end of fault output) appears. Refer to basic instructions for evaluation of flashing code.

Activating KE-Jetronic

This can only be performed following EI-K fault output "End". Press button for at least 4 seconds. Note down flashing code (SIS KE-Jetronic). Continue pressing button until flashing code 0 0 0 0 (end of fault output) appears.

Activating actuator diagnosis

Ignition OFF. Press button and keep it pressed. Ignition ON. Press button for at least 4 seconds. Flashing code indicates which actuator is actuated (SIS KE-Jetronic). Continue pressing button until flashing code 0 0 0 0 (end of fault output) appears. Do not switch off ignition.

SPECIAL FEATURES (CONTINUED)

Clearing fault memory

Fault memory can only be cleared following actuator diagnosis. Press button for at least 4 seconds. Fault memory is cleared. Fault lamp is OFF. Eliminate fault. Then perform test drive. Re-activate self-diagnosis (to check whether all faults eliminated).

- * Trouble-shooting and fault elimination for the test step MAGNETIC-PULSE-GENERATOR FUNCTION are to be performed as follows:
1. Detach ignition-distributor plug and EI-K control-unit plug and check lead term. 24 for open circuit, short to ground or short to positive. Eliminate fault.

2. Attach EI-K control-unit plug. Connect voltmeter to ignition-distributor plug term. 24 (+) and vehicle ground (-).

Note:

Use voltmeter with internal resistance (R_i) greater than 50 k Ω /V (otherwise measurement incorrect). Ignition ON.

Set value: equal to/greater than 2 V

Renew EI-K control unit if set value was not attained.

Renew magnetic pulse generator or ignition distributor if items 1 and 2 were O.K.

SPECIAL FEATURES (CONTINUED)

* Trouble-shooting and fault elimination for the test step EI-K CONTROL-UNIT FUNCTION are to be performed as follows:
If set value (rectangular pulse at least 2.5 V) was not attained, check lead from EI-K control unit term. 16 to trigger-box plug term. 2 for open circuit or short to ground.
Eliminate open circuit, short to ground.
Attach EI-K control-unit plug.
Detach trigger-box plug and connect resistance of between 240 and 270 Ω (e.g. commercially available decade resistor) to term. 2 and term. 3.
Connect oscilloscope "special" with red terminal to trigger-box plug term. 2 (+).
Black terminal to vehicle ground (-).
Start engine.
Oscilloscope must indicate a rectangular pulse of at least 2.5 V.

Renew trigger box if set value attained.

Renew EI-K control unit if set value not attained.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!

High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

TROUBLE-SHOOTING CHART

Customer complaint (symptoms of trouble)

1. Starting motor operates, engine fails to start or starts only with difficulty
2. Engine starts but then dies
3. Idle problems (engine speed, exhaust)
4. Poor throttle response.
5. Engine missing (ignition, injection)
6. Insufficient maximum power/speed
7. Excessive fuel consumption
8. Engine diesels
9. Engine pings/knocks
10. Engine overheats
11. Fault lamp.

Cause (component fault)										
*	*	*	*	*	*	*	*	*	*	Self-diagnosis
*			*							High-voltage side
*			*							Ignition coil
*										Firing sequence
*										Voltage - EI-K control unit
*										Ignition-distributor plug and socket
*										Voltage, magnetic pulse generator
*										Function, magnetic pulse generator
*										EI-K control units, function
*										Voltage, trigger box
*										Primary signal
*										Triggering, electric fuel pump relay

TROUBLE-SHOOTING CHART (continued)

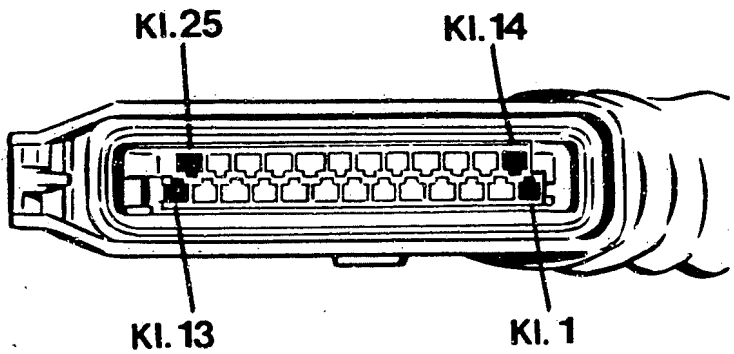
Customer complaint (symtoms of trouble)

1. Starting motor operates, engine fails to start or starts with difficulty.
2. Engine starts but then dies.
3. Idle problems (engine speed, exhaust).
4. Poor throttle response.
5. Engine missing (Ignition, injection).
6. Insufficient maximum power/speed.
7. Excessive fuel consumption.
8. Engine diesels.
9. Engine pings/knocks.
10. Engine overheats.
11. Fault lamp.

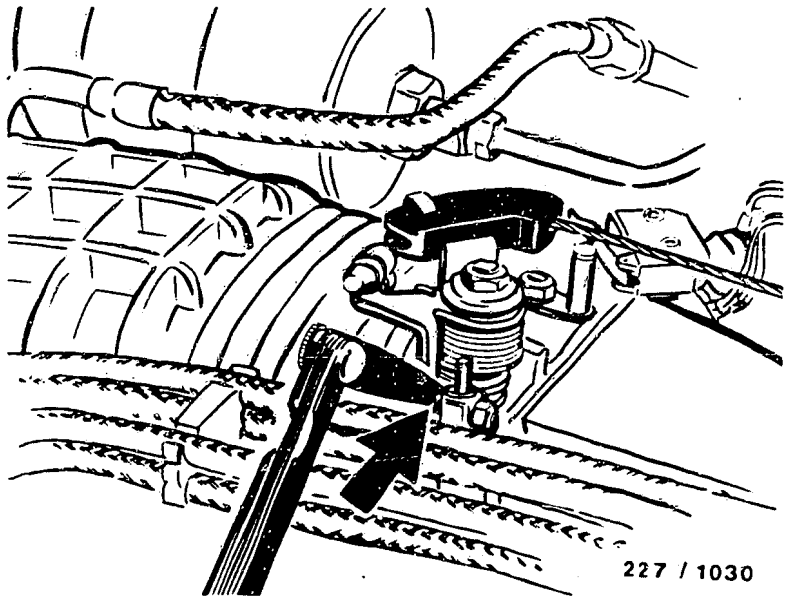
Cause (component fault)										
*										Contact resistance
*										Ignition distributor installation setting
									*	Fault lamp
*				*	*		*	*	*	Basic ignition setting
			*							Voltage, EI-K control unit
			*							Voltage, ignition coil

SELF-DIAGNOSIS TEST TABLE

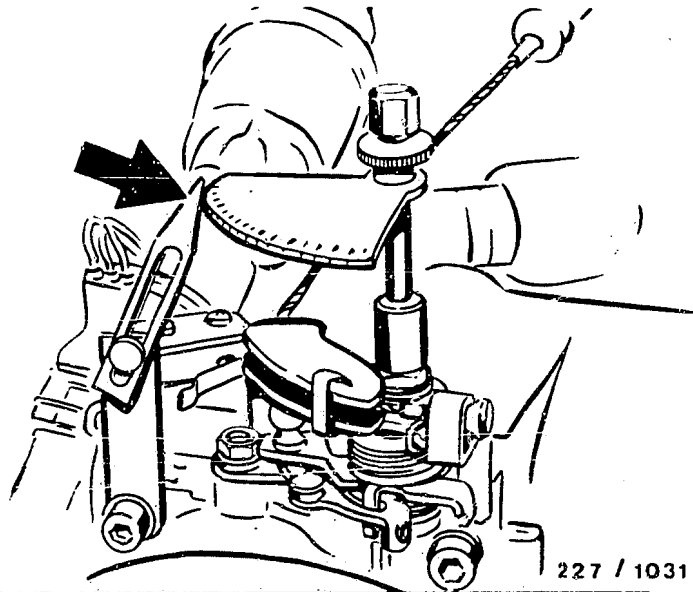
Fault display Flash code	Testing of component/function Test instructions/conditions	Term.	Set values
1 1 1 1	EI-K CONTROL UNIT Replace EI-K control unit.	—	—
2 1 2 1	THROTTLE-VALVE SWITCH - IDLE Voltage, EI-K control-unit plug. Upper illustration. Throttle valve in idle position. Ignition ON. Feeler gauge 0,5...0,7 mm between throttle-valve stop and adjusting screw. See center illustration, arrow.	7 20 (+) (-)	approx. battery voltage 0 V
2 1 2 3	THROTTLE-VALVE SWITCH - FULL LOAD Voltage, EI-K control-unit plug. Throttle valve in idle position. Ignition ON. Graduated disc on throttle valve level 1. See lower illustration, arrow. 68...76° after idle position.	9 20 (+) (-)	0 V approx. battery voltage.



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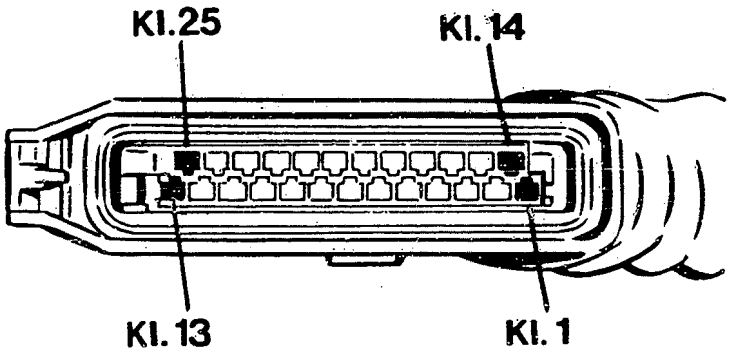
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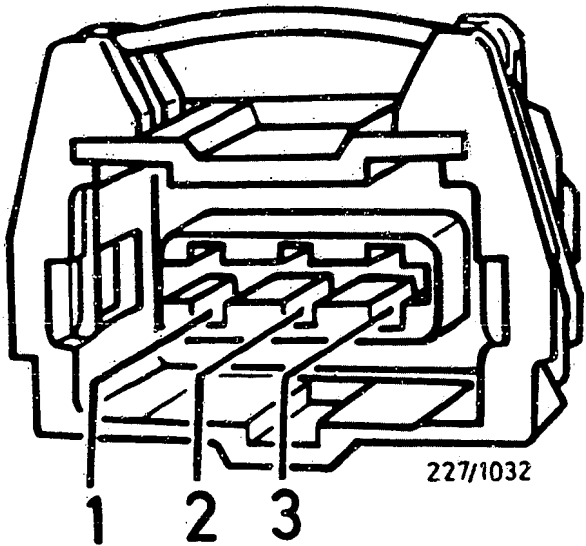
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SELF-DIAGNOSIS TEST TABLE (Continued)

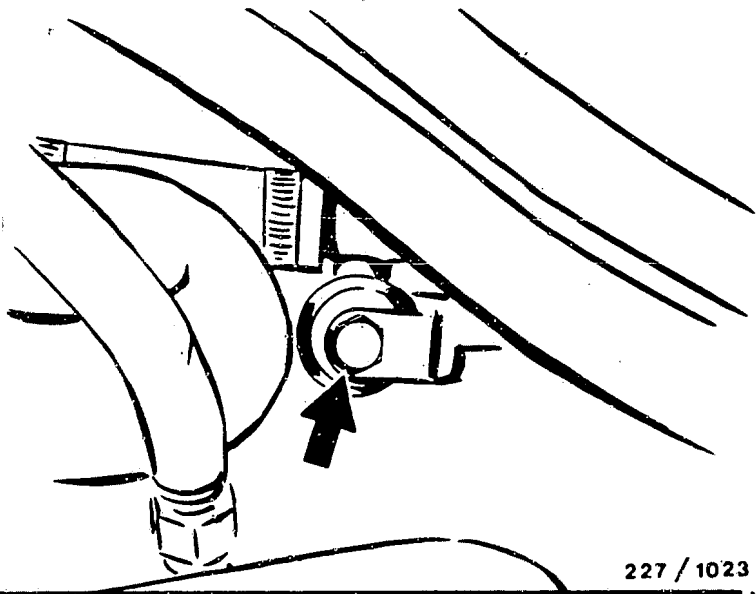
Fault display Flash code	Testing of component/function Test instructions/conditions	Term.	Set values
2 1 4 1	MAXIMUM RETARDATION OF KNOCK CONTROL Fuel with insufficient octane number, Check ignition-point adjustment, fuel- injection. Bearing damage, abnormal engine noises.	—	—
2 1 4 2	KNOCK SENSOR Resistance of EI-K control-unit plug (upper illustration) and knock-sensor plug connection (center illustration). Resistance of knock-sensor plug connec. See center illustration. Tightening torque. See lower ill., arrow.	13 1 12 2 12 3 1 2	approx. 0 Ω approx. 0 Ω approx. 0 Ω infinite Ω 15–25 Nm
2 2 2 3	ALTITUDE SENSOR Voltage of EI-K control-unit plug. See upper illustration. Ignition ON.	2 20 (+) (–)	Sea level = 3,2...4,7V 500 m = 2,8...4,0V 1000m = 2,4...3,5V 1500m = 2,0...3,0V 2000m = 1,5...2,5V 3000m = 0,8...1,6V



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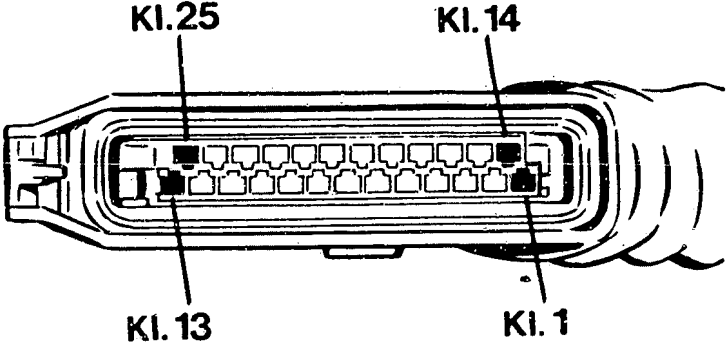
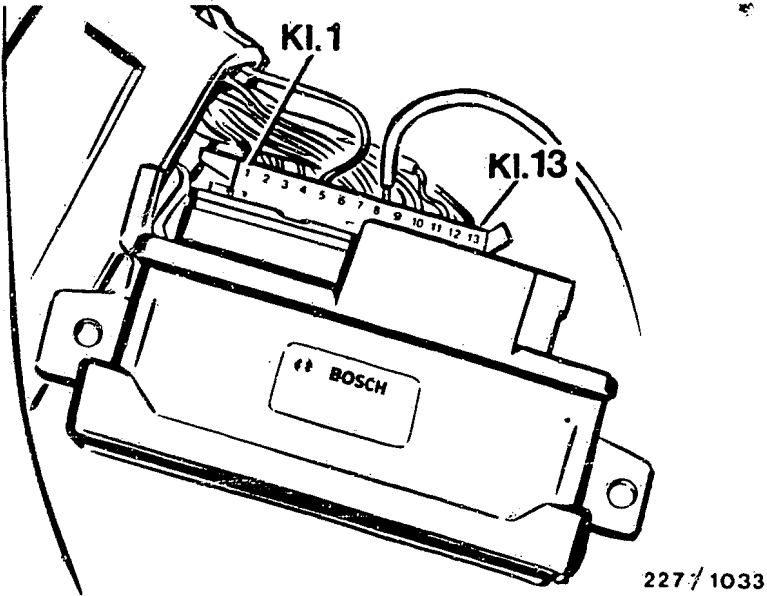
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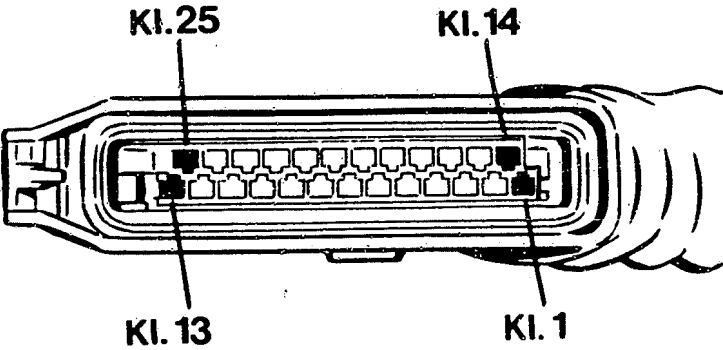
SELF-DIAGNOSIS TEST TABLE (Continued)

Fault display Flash code	Testing of component/function Test instructions/conditions	Term.	Set values
2 2 3 2	LOAD SIGNAL Voltage, EI-K control-unit plug with handle cover removed. See upper illustration. Engine at idle.	8 20 (+) (-)	0,2...4,6 V
2 2 3 3	REFERENCE VOLTAGE FOR LOAD- AND ALTITUDE-SENSOR SIGNAL Voltage, EI-K control-unit plug. See lower illustration. Ignition ON.	21 20 (+) (-)	4,5...5,1 V
2 3 1 2	TEMPERATURE SENSOR - COOLANT Resistance of EI-K control-unit plug. See lower illustration.	25 20	+ 20°C=2,1...2,9k Ω + 30°C=1,4...2,0k Ω + 80°C=280...370 Ω + 90°C=210...280 Ω +100°C=160...210 Ω
4 4 4 4	NO FAULT IN MEMORY	—	—
0 0 0 0	END OF FAULT OUTPUT	—	—

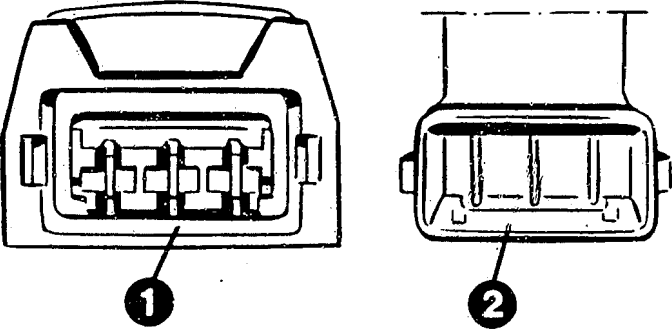


RAPID DIAGNOSIS CHART

Test step	Testing of component/function Test instructions/conditions	Term.	Set values
1	HIGH-VOLTAGE SIDE For example, check spark plugs, ignition harness, distributor cap, etc. for proper operation (e.g. open circuits, shunt). Evaluate with ignition oscillogram, resistance measurement, visual check for example.	—	—
2	IGNITION COIL Visual check (Bosch only): Are seal plugs present, has sealing compound escaped? Primary resistance (Bosch) Secondary resistance (non-Bosch) Primary resistance (Bosch) Secondary resistance (non-Bosch)	— 1 15 1 15 1 4 1 4	— 0,6... 1,0 Ω 0,5... 1,5 Ω 6,4...11,1 k Ω 5,0... 9,0 k Ω
3	VOLTAGE SUPPLY, EI-K CONTROL UNIT Disconnect EI-K control-unit plug. Ignition ON. Voltage of EI-K control-unit plug. See upper illustration.	6 20 (+) (-)	Battery voltage
4	IGNITION-DISTRIBUTOR PLUG AND SOCKET Disconnect ignition-distributor plug. Visual check: Check ignition-distributor plug and socket for oxidation. See lower illustration.	—	—



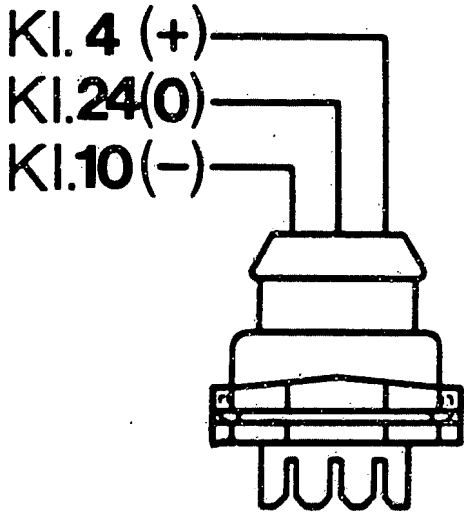
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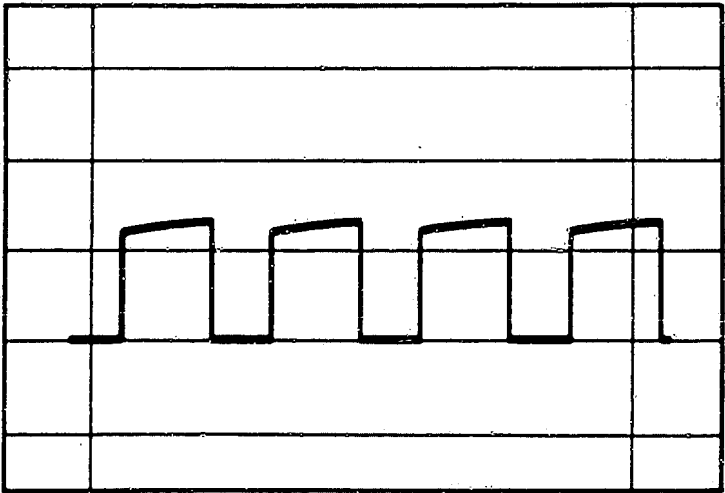
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RAPID DIAGNOSIS CHART (continued)

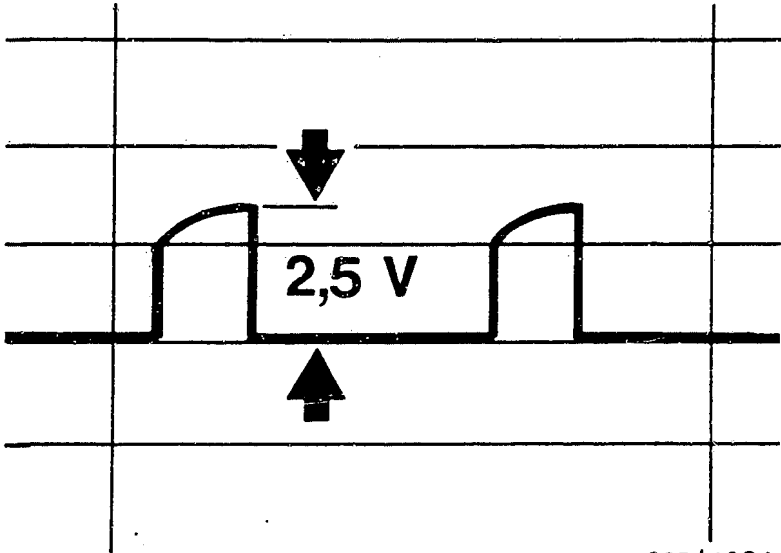
Test step	Testing of component/function Test instructions/conditions	Terminals	Set values
5	VOLTAGE SUPPLY, MAGNETIC PULSE GENERATOR Attach ignition-distributor and EI-K control-unit plug. Ignition ON. Voltage, ignition-distributor plug. See top picture.	4 10 (+) (-)	Equal to/greater than 10 V
6	MAGNETIC-PULSE-GENERATOR FUNCTION Start engine. Oscilloscope "special" to ignition-distributor plug. See top picture.	24 B- (+) (-)	Rectangular pulse (center picture)
7	EI-K CONTROL-UNIT FUNCTION Trigger-box, ignition-distributor and EI-K control-unit plug attached. Oscilloscope "special" to trigger-box plug. Start engine. * Note: The minimum voltage is important and not the profile (edges may be smooth)	2 B- (+) (-)	* Rectangular pulse equal to/greater than 2.5 V (bottom picture)
8	VOLTAGE SUPPLY, TRIGGER BOX Detach trigger-box plug. Ignition ON. Voltage, trigger-box plug.	1 3 (+) (-)	Battery voltage



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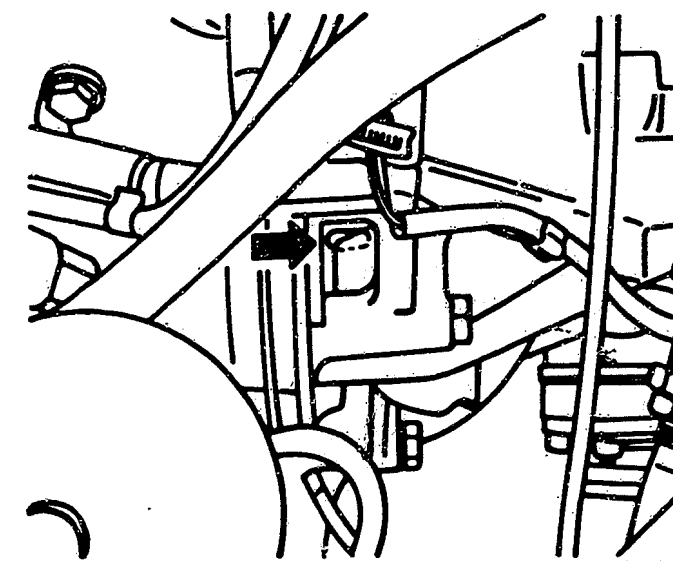


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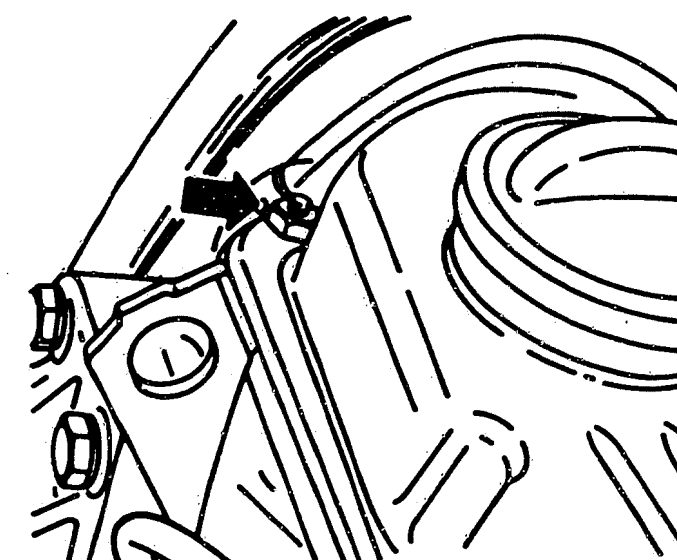
RAPID DIAGNOSIS CHART (Continued)

Test step	Testing of component/function Test instructions/conditions	Term.	Set values
9	PRIMARY SIGNAL EI-K control-unit, trigger-box, and ignition-distributor plugs connected. Start engine. Oscilloscope/engine-speed tester to ign. coil.	15 1 (+) (-)	Primary voltage - engine-speed display (level unimportant)
10	TRIGGERING, ELECTRIC FUEL PUMP RELAY Ignition ON. The electric fuel pump relay including the electric fuel pump are triggered (can be heard).	—	Triggering approx. 1 second
11*	CONTACT RESISTANCES Check trigger-box voltage supply leads or primary circuit for contact resistance.	various	max. 0,5 Ω
12*	IGNITION-DISTRIBUTOR INSTALLATION SETTING Engine cyl. 1 at TDC. Upper illustration. Camshaft marking aligns with upper edge of valve-cover seal. Center illustration. Middle of distributor rotor points to housing marking. Lower illustration.	—	—
13	FAULT LAMP Ignition ON. Engine at idle.	— —	Fault lamp lights up Fault lamp OFF

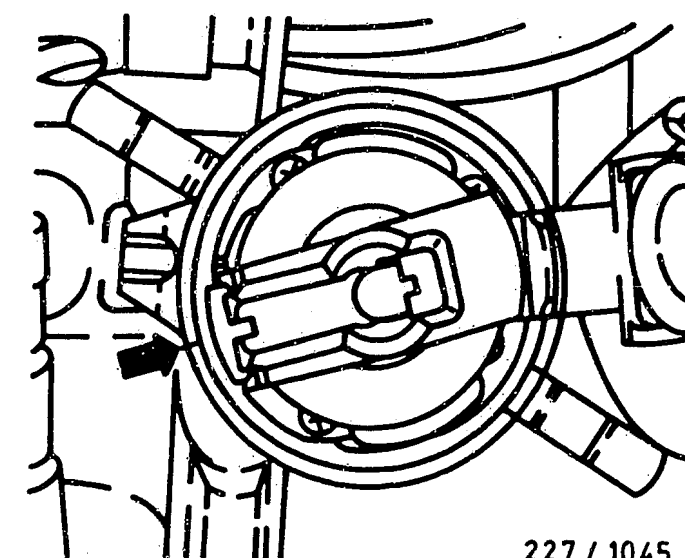
* carry out only when engine not running.



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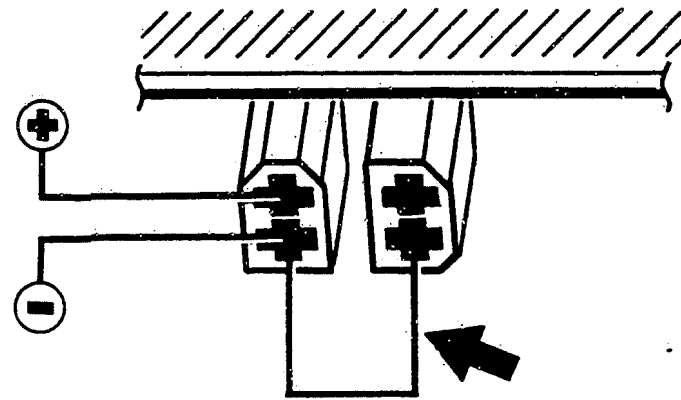
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RAPID DIAGNOSIS CHART (continued)

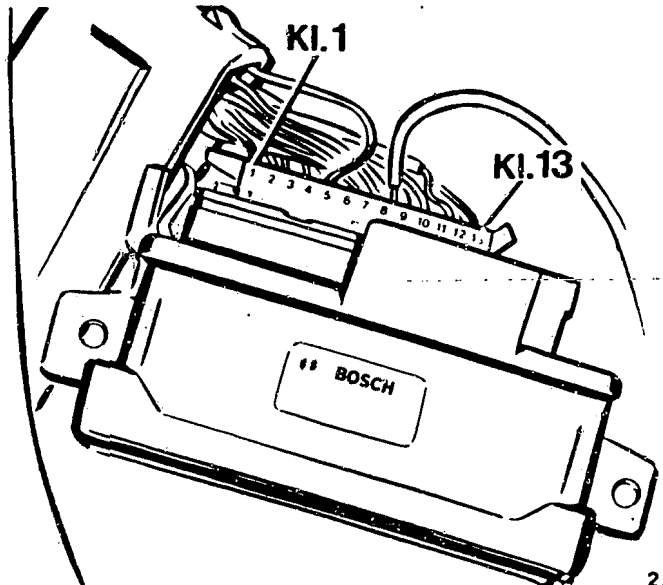
Test step	Testing of component/function Test instructions/conditions	Terminals	Set values
14	BASIC IGNITION SETTING Engine oil temperature min. 80°C Throttle valve in idle position. A/C switched off. Fault lamp must not flash. Jumper diagnosis plug connections with measurement lead (until completion of testing). See top picture, arrow. Engine idling. Note: setting $15 \pm 1^\circ$ BTDC See center picture, arrow.	—	13 - 17° BTDC
15	VOLTAGE SUPPLY, EI-K CONTROL UNIT Voltage, EI-K control-unit plug with handle cover removed. See bottom picture. Engine idling.	6 20 (+) (-)	12 - 14 V max. 2 V below U_B
16	VOLTAGE SUPPLY, IGNITION COIL Engine idling. Voltage, ignition coil and battery.	15 B- (+) (-)	equal to/greater than 10 V



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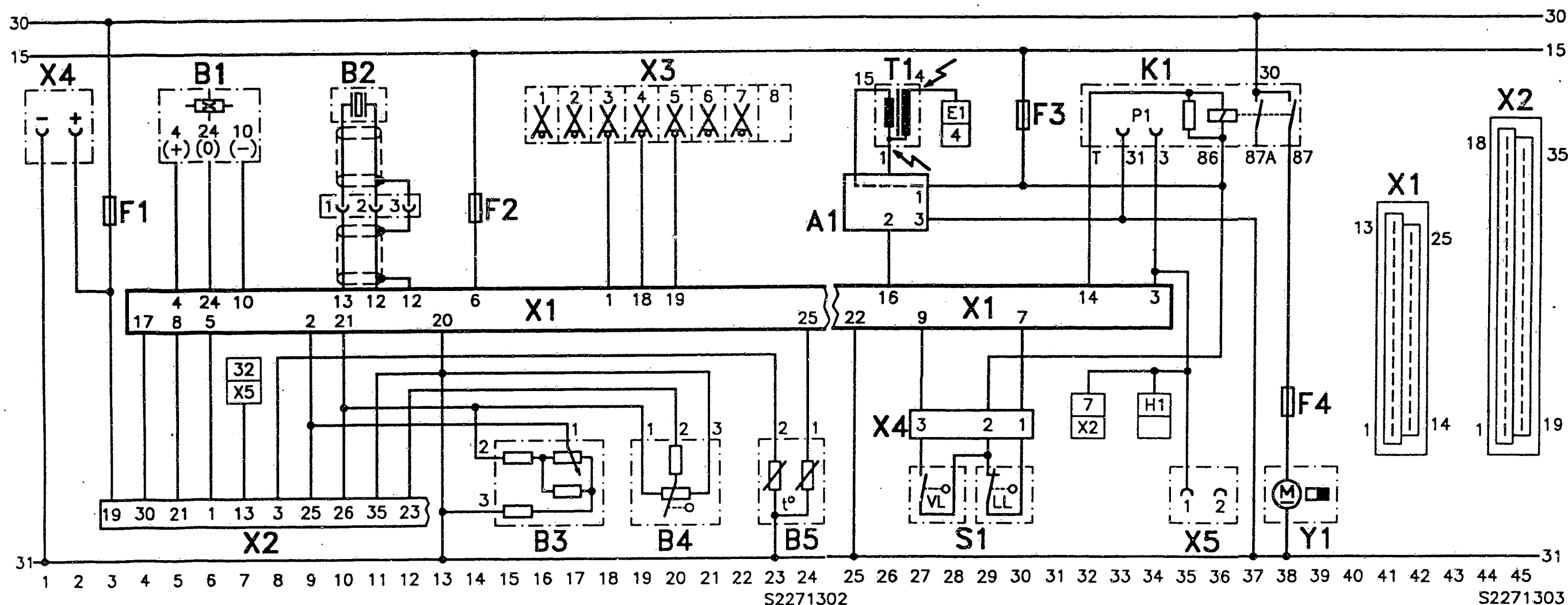
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TEST SPECIFICATIONS

Throttle-valve switch (idle) with ignition ON in idle position	approx. battery voltage
Feeler gauge between throttle-valve stop	0,5...0,7 mm 0 V
Throttle-valve switch (full load) Idle position	0 V
Throttle valve Open with ignition ON	68...76° approx. battery voltage
Knock sensor Tightening torque	15...25 Nm
Altitude sensor	
Sea level	3,2...4,7 V
500 m	2,8...4,0 V
1000 m	2,4...3,5 V
1500 m	2,0...3,0 V
2000 m	1,5...2,5 V
3000 m	0,8...1,6 V
Load signal with engine idling	0,2...4,6 V
Reference voltage for load and altitude sensor with ignition ON	4,5...5,1 V
Temperature sensor (coolant)	
+20° C	2,1...2,9 k Ω
+30° C	1,4...2,0 k Ω
+80° C	280...370 Ω
+90° C	210...280 Ω
+100° C	160...210 Ω
Ignition coil	
Primary (Bosch)	0,6... 1,0 Ω
Primary (Non-Bosch)	0,5... 1,5 Ω
Secondary (Bosch)	6,4...11,1 k Ω
Secondary (Non-Bosch)	5,0... 9,0 k Ω
Voltage supply EI-K control unit with ignition ON	Battery voltage
Voltage supply Magnetic pulse generator with ignition on	equal to/greater than 10 V

TEST SPECIFICATIONS (CONTINUED)

Magnetic-pulse-generator function at cranking speed	Rectangular pulse
EI-K control-unit function at cranking speed	Rectangular pulse
Voltage supply, trigger box with ignition ON	Battery voltage
Primary signal at cranking speed	Primary voltage/ engine-speed indication
Actuation, electric-fuel-pump relay with ignition ON	approx. 1 second (audible)
Contact resistance Supply leads, trigger box or primary circuit	max.0,5 Ω
Ignition-distributor as-assembled setting	Cyl.1 TDC ID mark
Fault lamp Ignition ON with engine idling	Lights up OFF
Basic ignition setting Electric-fuel-pump relay jumpered Engine idling	13...17° BTDC (setting) 15 \pm 1° BTDC
Voltage supply EI-K control unit Engine idling	12...14 V max.2 V below U _B
Voltage supply Ignition coil Engine idling	equal to/ greater than 10 V
Refer to SIS Microcard "Jetronic" or Autodata test specifications for settings as regards idle speed, exhaust emissions, valve clearance etc.	



ELECTRICAL TERMINAL DIAGRAM

High-tension arrows: Caution 400 V...25 kV

A1 = Trigger box
 B1 = Magnetic pulse generator
 B2 = Knock sensor
 B3 = Altitude sensor
 B4 = Air-flow sensor (potentiometer)
 B5 = Temperature sensor (coolant)
 E1 = to ignition distributor

F1...4 = Fuses
 H1 = Fault lamp
 K1 = Electric-fuel-pump relay
 P1 = Contacts (previously diagnosis)
 S1 = Throttle-valve switch
 Idl = full load
 T1 = Ignition coil
 X1 = EI-K control-unit plug

X2 = KE-Jetronic control-unit plug
 X3 = Encoding plug
 X4 = Diagnosis plug connection
 X5 = Diagnosis plug connection (stimulation lead)
 Y1 = Electric fuel pump

INSTALLATION POSITION OF COMPONENTS

The EI-K control unit is located in the footwell on the driver's side.

The altitude sensor is located in the driver's side footwell above the EI-K control unit.

The KE-Jetronic control unit is located in the passenger-side footwell.

Variant encoding unit is located in the footwell on the passenger's side in a plastic case near the KE-Jetronic control unit.

The coolant temperature sensor is located near the spark plug of cyl. 1

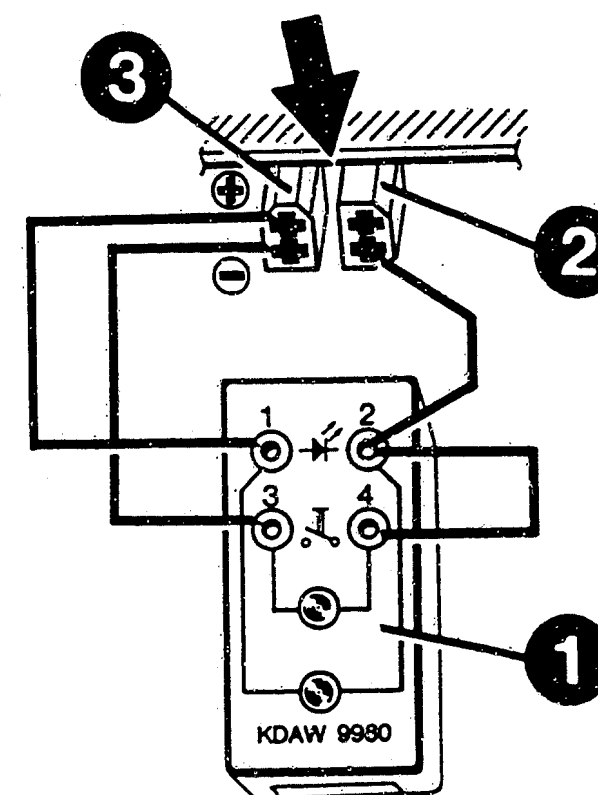
The idle/full-load throttle-valve switch is located on the throttle-valve assembly.

The trigger box and ignition coil are located near the windshield-washer fluid container.

The knock sensor is located near the left engine mounting.

The electric fuel pump relay is located in the central electrics box.

The fault lamp is located on the instrument panel.



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- 1 = Evaluation unit KDAW 9980
- 2 = Diagnosis plug connection (* brown)
- 3 = Diagnosis plug connection (* black)

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

Diagnosis plug connections are located in the footwell (driver's side) at the front on the heating duct.

* Color may change.

Trouble-shooting instructions: AUD-5020

BOSCH system : EI-K

Vehicle make : Audi

Basic microcard : PKW-051

TABLE OF CONTENTS

Section	Coordinates
Special features, use, safety	02
Trouble-shooting chart	07
Self-diagnosis test table	09
Rapid diagnosis chart	15
Test specifications	23
Electrical terminal diagram	25
Installation position of components, instructions for removal and installation	27

SPECIAL FEATURES

These brief instructions, valid at the time of publication, apply to the following Audi model:
Audi 90, 90 quattro, 2.3 E, USA-Cal.
Engine 2.3 l, 5 cyl. 100 kW code letters NG
9.88 ->

- * EI-K control unit 0 227 400 136
EI-K control unit 0 227 400 167,...160
4.89 ->
- * Ignition coil with trigger box 0 221 600 050
- * Ignition coil without trigger box 0 221 122 358
- * Variant encoding
- * Self-diagnosis :
As of model year 1989 there is no activation of the self-diagnosis via the electric-fuel-pump relay or evaluation of the flashing code by way of a fault lamp in the instrument cluster.
Activation/evaluation of the flashing code is effected with the EVALUATION UNIT KDAW 9980 by way of 2 diagnosis plug connections located in the footwell (driver's side).
The evaluation-unit button is pressed instead of "bridge electric-fuel-pump relay".
Refer to INSTALLATION POSITION OF COMPONENTS for connection of evaluation unit to diagnosis plug connections.

The KE-Jetronic control unit is equipped with a permanent memory. EI-K control-unit faults are also stored in this memory. Fault output is effected separately according to EI-K and KE-Jetronic.

Prerequisites:
Fuses 13, 19, 21, 27, 28 O.K.
Intake-manifold ground connection O.K.

SPECIAL FEATURES (CONTINUED)

The following test sequence must be complied with:

Activating EI-K

(With fault memory cleared perform test drive for at least 5 minutes on road/roller dynamometer at engine speed in excess of 3000 min⁻¹. In doing so, briefly depress accelerator pedal as far as it will go. Or if engine won't go, actuate starting motor for approx. 6 seconds).

Ignition OFF. Ignition ON. Press button of evaluation unit KDAW 9980 for at least 4 seconds. Note down flashing code. Continue pressing button until flashing code 0 0 0 0 (end of fault output) appears. Refer to basic instructions for evaluation of flashing code.

Activating KE-Jetronic

This can only be performed following EI-K fault output "End". Press button for at least 4 seconds. Note down flashing code (SIS KE-Jetronic). Continue pressing button until flashing code 0 0 0 0 (end of fault output) appears.

Activating actuator diagnosis

Ignition OFF. Press button and keep it pressed. Ignition ON. Press button for at least 4 seconds. Flashing code indicates which actuator is actuated (SIS KE-Jetronic). Continue pressing button until flashing code 0 0 0 0 (end of fault output) appears. Do not switch off ignition.

SPECIAL FEATURES (CONTINUED)

Clearing fault memory

Fault memory can only be cleared following actuator diagnosis. Press button for at least 4 seconds. Fault memory is cleared. Fault lamp is OFF. Eliminate fault. Then perform test drive. Re-activate self-diagnosis (to check whether all faults eliminated).

- * Trouble-shooting and fault elimination for the test step MAGNETIC-PULSE-GENERATOR FUNCTION are to be performed as follows:
1. Detach ignition-distributor plug and EI-K control-unit plug and check lead term. 24 for open circuit, short to ground or short to positive. Eliminate fault.

2. Attach EI-K control-unit plug. Connect voltmeter to ignition-distributor plug term. 24 (+) and vehicle ground (-).

Note:

Use voltmeter with internal resistance (R_i) greater than 50 k Ω /V (otherwise measurement incorrect).

Ignition ON.

Set value: equal to/greater than 2 V

Renew EI-K control unit if set value was not attained.

Renew magnetic pulse generator or ignition distributor if items 1 and 2 were O.K.

SPECIAL FEATURES (CONTINUED)

* Trouble-shooting and fault elimination for the test step EI-K CONTROL-UNIT FUNCTION are to be performed as follows:
If set value (rectangular pulse at least 2.5 V) was not attained, check lead from EI-K control unit term. 16 to trigger-box plug term. 2 for open circuit or short to ground.
Eliminate open circuit, short to ground.
Attach EI-K control-unit plug.
Detach trigger-box plug and connect resistance of between 240 and 270 Ω (e.g. commercially available decade resistor) to term. 2 and term. 3.
Connect oscilloscope "special" with red terminal to trigger-box plug term. 2 (+).
Black terminal to vehicle ground (-).
Start engine.
Oscilloscope must indicate a rectangular pulse of at least 2.5 V.

Renew trigger box if set value attained.

Renew EI-K control unit if set value not attained.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!

High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

TROUBLE-SHOOTING CHART

Customer complaint (symptoms of trouble)

1. Starting motor operates, engine fails to start or starts only with difficulty
2. Engine starts but then dies
3. Idle problems (engine speed, exhaust)
4. Poor throttle response.
5. Engine missing (ignition, injection)
6. Insufficient maximum power/speed
7. Excessive fuel consumption
8. Engine diesels
9. Engine pings/knocks
10. Engine overheats
11. Fault lamp.

Cause (component fault)										
*	*	*	*	*	*	*	*	*	*	Self-diagnosis
*			*							High-voltage side
*			*							Ignition coil
*										Firing sequence
*										Voltage - EI-K control unit
*										Ignition-distributor plug and socket
*										Voltage, magnetic pulse generator
*										Function, magnetic pulse generator
*										EI-K control units, function
*										Voltage, trigger box
*										Primary signal
*										Triggering, electric fuel pump relay

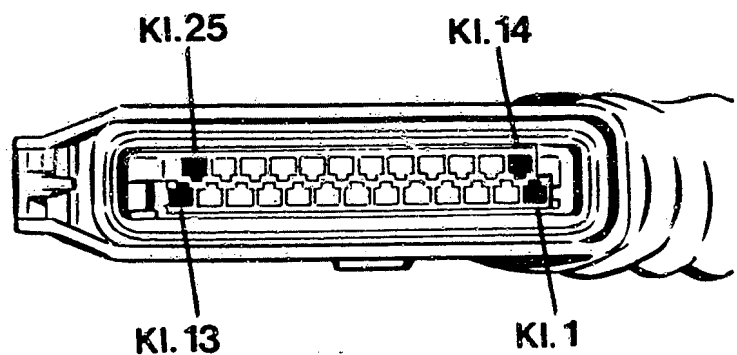
TROUBLE-SHOOTING CHART (continued)
Customer complaint (symtoms of trouble)

1. Starting motor operates, engine fails to start or starts with difficulty.
2. Engine starts but then dies.
3. Idle problems (engine speed , exhaust).
4. Poor throttle response.
5. Engine missing (Ignition, injection).
6. Insufficient maximum power/speed.
7. Excessive fuel consumption.
8. Engine diesels.
9. Engine pings/knocks.
10. Engine overheats.
11. Fault lamp.

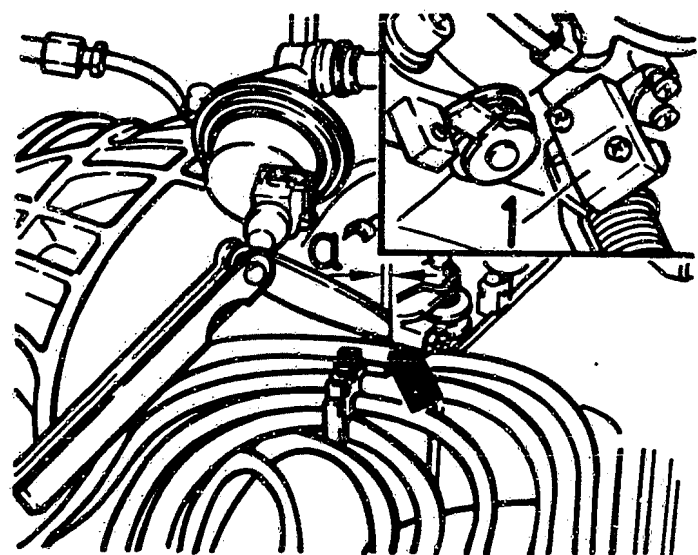
Cause (component fault)										
*										Contact resistance
*										Ignition distributor installation setting
								*		Fault lamp
*			*	*	*	*	*	*		Basic ignition setting
			*							Voltage, EI-K control unit
			*							Voltage, ignition coil

SELF-DIAGNOSIS TEST TABLE

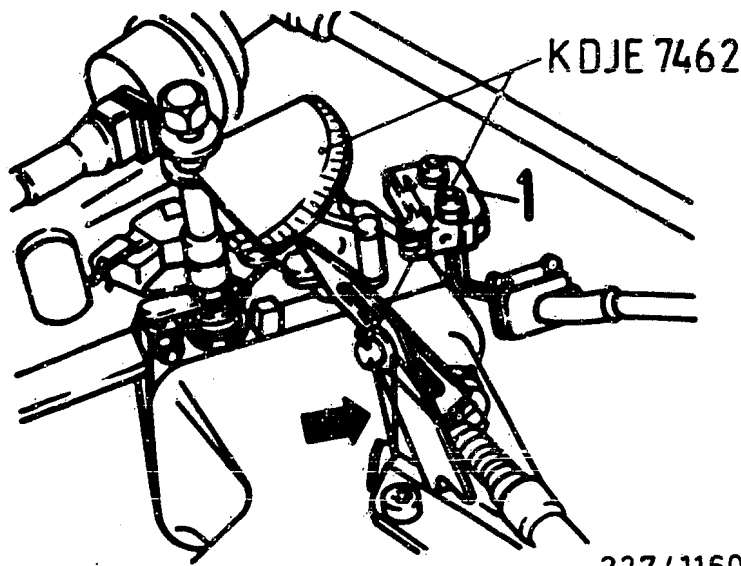
Fault display Flash code	Testing of component/function Test instructions/conditions	Term.	Set values
1 1 1 1	EI-K CONTROL UNIT Replace EI-K control unit.	—	—
2 1 2 1	THROTTLE-VALVE SWITCH - IDLE Voltage, EI-K control-unit plug. Upper illustration. Throttle valve in idle position. Ignition ON. Feeler gauge 0,5...0,7 mm between throttle-valve stop and adjusting screw. See center illustration, arrow.	7 20 (+) (-)	approx. battery voltage 0 V
2 1 2 3	THROTTLE-VALVE SWITCH - FULL LOAD Voltage, EI-K control-unit plug. Throttle valve in idle position. Ignition ON. Graduated disc on throttle valve level 1. See lower illustration, arrow. 68...76° after idle position.	9 20 (+) (-)	0 V approx. battery voltage.



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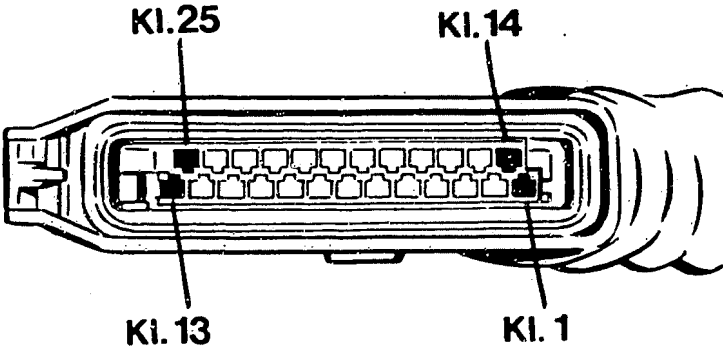
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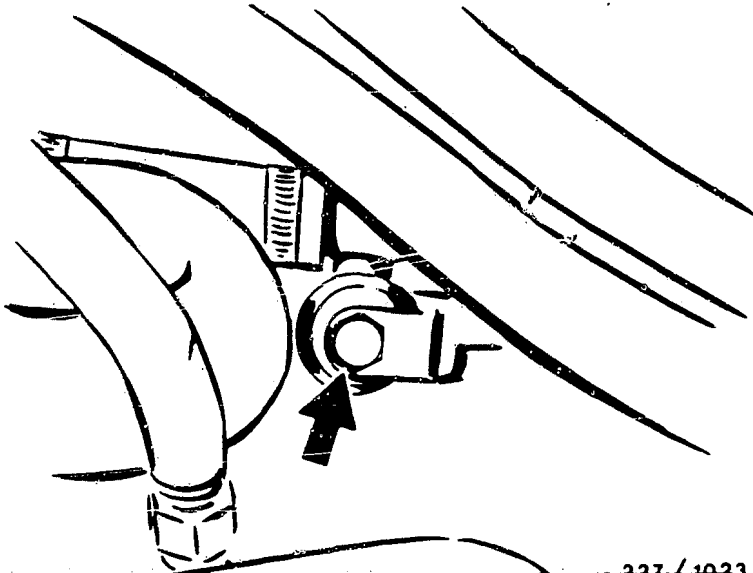
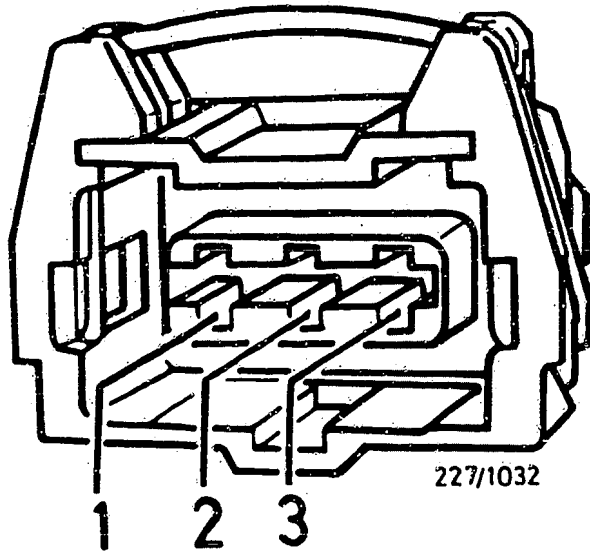
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SELF-DIAGNOSIS TEST TABLE (Continued)

Fault display Flash code	Testing of component/function Test instructions/conditions	Term.	Set values
2 1 4 1	MAXIMUM RETARDATION OF KNOCK CONTROL Fuel with insufficient octane number, Check ignition-point adjustment, fuel- injection. Bearing damage, abnormal engine noises.	—	—
2 1 4 2	KNOCK SENSOR Resistance of EI-K control-unit plug (upper illustration) and knock-sensor plug connection (center illustration). Resistance of knock-sensor plug connec. See center illustration. Tightening torque. See lower ill., arrow.	13 1 12 2 12 3 1 2	approx. 0 Ω approx. 0 Ω approx. 0 Ω infinite Ω 15–25 Nm
2 2 2 3	ALTITUDE SENSOR Voltage of EI-K control-unit plug. See upper illustration. Ignition ON.	2 20 (+) (–)	Sea level = 3,2...4,7V 500 m = 2,8...4,0V 1000m = 2,4...3,5V 1500m = 2,0...3,0V 2000m = 1,5...2,5V 3000m = 0,8...1,6V



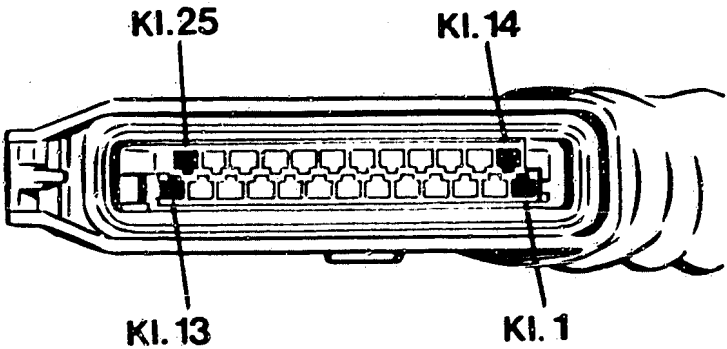
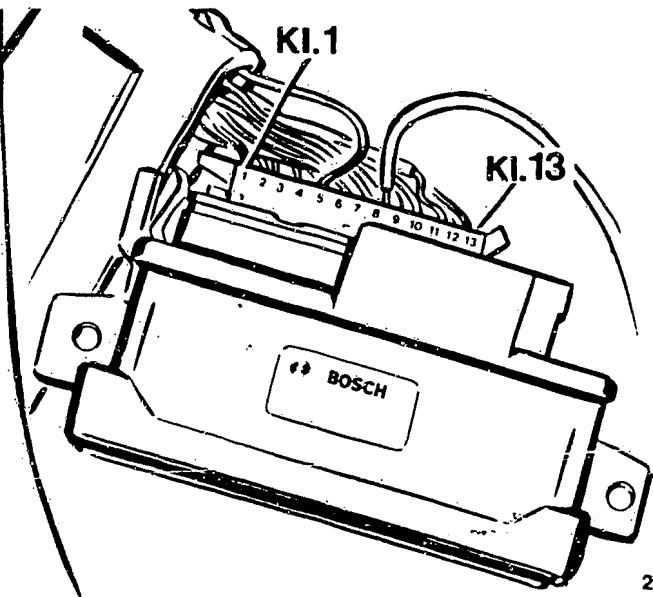
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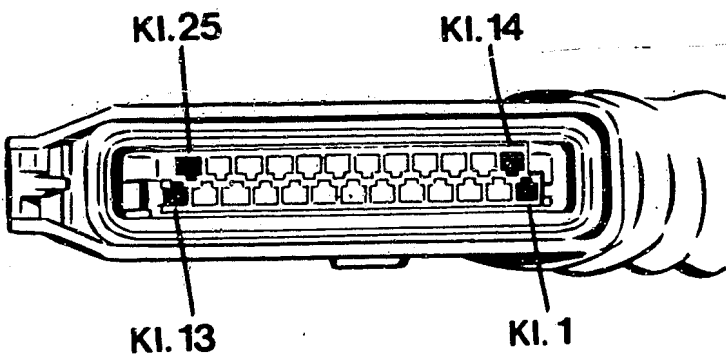
SELF-DIAGNOSIS TEST TABLE (Continued)

Fault display Flash code	Testing of component/function Test instructions/conditions	Term.	Set values
2 2 3 2	LOAD SIGNAL Voltage, EI-K control-unit plug with handle cover removed. See upper illustration. Engine at idle.	8 20 (+) (-)	0,2...4,6 V
2 2 3 3	REFERENCE VOLTAGE FOR LOAD- AND ALTITUDE-SENSOR SIGNAL Voltage, EI-K control-unit plug. See lower illustration. Ignition ON.	21 20 (+) (-)	4,5...5,1 V
2 3 1 2	TEMPERATURE SENSOR - COOLANT Resistance of EI-K control-unit plug. See lower illustration.	25 20	+ 20°C=2,1...2,9k Ω + 30°C=1,4...2,0k Ω + 80°C=280...370 Ω + 90°C=210...280 Ω +100°C=160...210 Ω
4 4 4 4	NO FAULT IN MEMORY	—	—
0 0 0 0	END OF FAULT OUTPUT	—	—

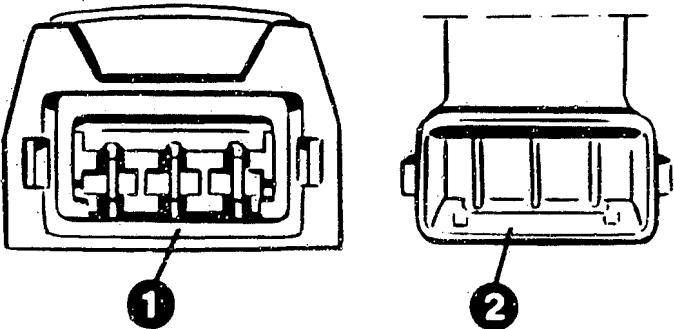


RAPID DIAGNOSIS CHART

Test step	Testing of component/function Test instructions/conditions	Term.	Set values
1	HIGH-VOLTAGE SIDE For example, check spark plugs, ignition harness, distributor cap, etc. for proper operation (e.g. open circuits, shunt). Evaluate with ignition oscillogram, resistance measurement, visual check for example.	—	—
2	IGNITION COIL Visual check (Bosch only): Are seal plugs present, has sealing compound escaped? Primary resistance (Bosch) Secondary resistance (non-Bosch) Primary resistance (Bosch) Secondary resistance (non-Bosch)	— 1 15 1 15 1 4 1 4	— 0,6... 1,0 Ω 0,5... 1,5 Ω 6,4...11,1 k Ω 5,0... 9,0 k Ω
3	VOLTAGE SUPPLY, EI-K CONTROL UNIT Disconnect EI-K control-unit plug. Ignition ON. Voltage of EI-K control-unit plug. See upper illustration.	6 20 (+) (-)	Battery voltage
4	IGNITION-DISTRIBUTOR PLUG AND SOCKET Disconnect ignition-distributor plug. Visual check: Check ignition-distributor plug and socket for oxidation. See lower illustration.	—	—

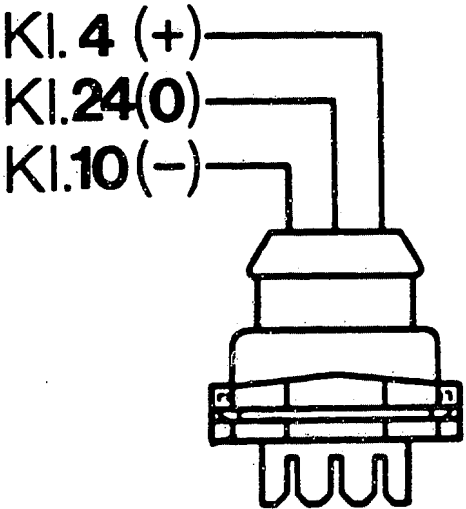


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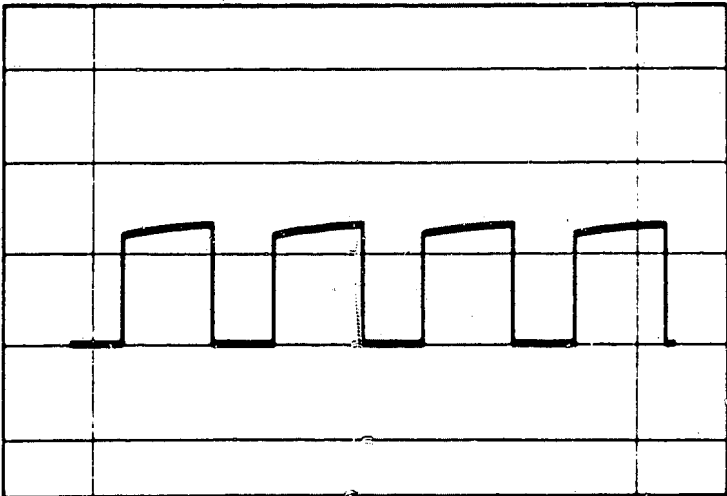


RAPID DIAGNOSIS CHART (continued)

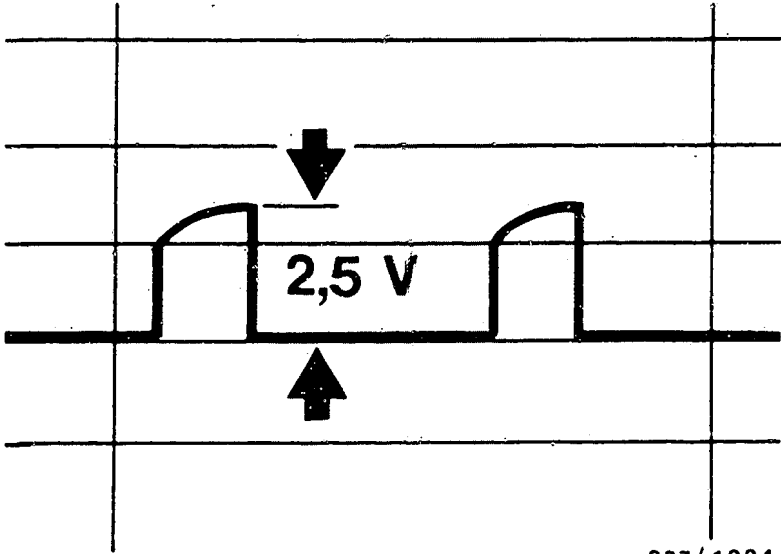
Test step	Testing of component/function Test instructions/conditions	Terminals	Set values
5	VOLTAGE SUPPLY, MAGNETIC PULSE GENERATOR Attach ignition-distributor and EI-K control-unit plug. Ignition ON. Voltage, ignition-distributor plug. See top picture.	4 10 (+) (-)	Equal to/greater than 10 V
6	MAGNETIC-PULSE-GENERATOR FUNCTION Start engine. Oscilloscope "special" to ignition-distributor plug. See top picture.	24 B- (+) (-)	Rectangular pulse (center picture)
7	EI-K CONTROL-UNIT FUNCTION Trigger-box, ignition-distributor and EI-K control-unit plug attached. Oscilloscope "special" to trigger-box plug. Start engine. * Note: The minimum voltage is important and not the profile (edges may be smooth)	2 B- (+) (-)	* Rectangular pulse equal to/greater than 2.5 V (bottom picture)
8	VOLTAGE SUPPLY, TRIGGER BOX Detach trigger-box plug. Ignition ON. Voltage, trigger-box plug.	1 3 (+) (-)	Battery voltage



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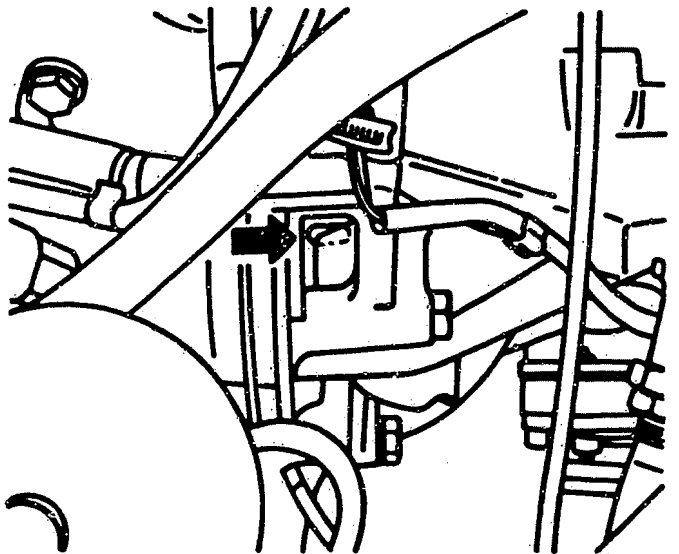


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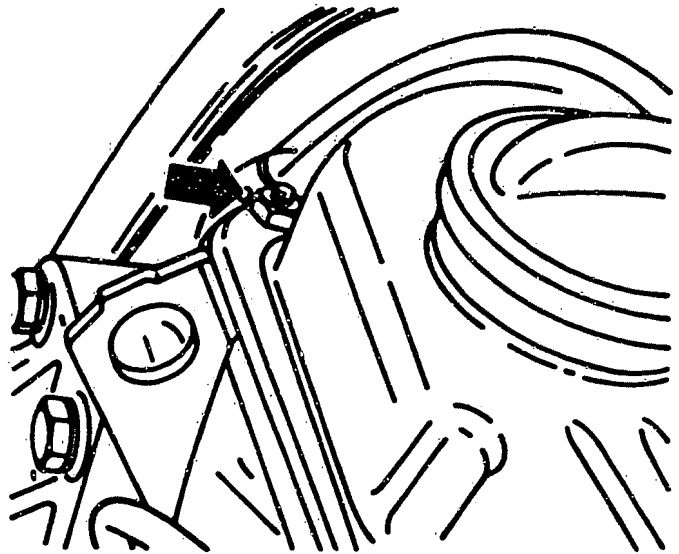
RAPID DIAGNOSIS CHART (Continued)

Test step	Testing of component/function Test instructions/conditions	Term.	Set values
9	PRIMARY SIGNAL EI-K control-unit, trigger-box, and ignition-distributor plugs connected. Start engine. Oscilloscope/engine-speed tester to ign. coil.	15 1 (+) (-)	Primary voltage - engine-speed display (level unimportant)
10	TRIGGERING, ELECTRIC FUEL PUMP RELAY Ignition ON. The electric fuel pump relay including the electric fuel pump are triggered (can be heard).	—	Triggering approx. 1 second
11*	CONTACT RESISTANCES Check trigger-box voltage supply leads or primary circuit for contact resistance.	various	max.0,5 Ω
12*	IGNITION-DISTRIBUTOR INSTALLATION SETTING Engine cyl. 1 at TDC. Upper illustration. Camshaft marking aligns with upper edge of valve-cover seal. Center illustration. Middle of distributor rotor points to housing marking. Lower illustration.	—	—
13	FAULT LAMP Ignition ON. Engine at idle.	— —	Fault lamp lights up Fault lamp OFF

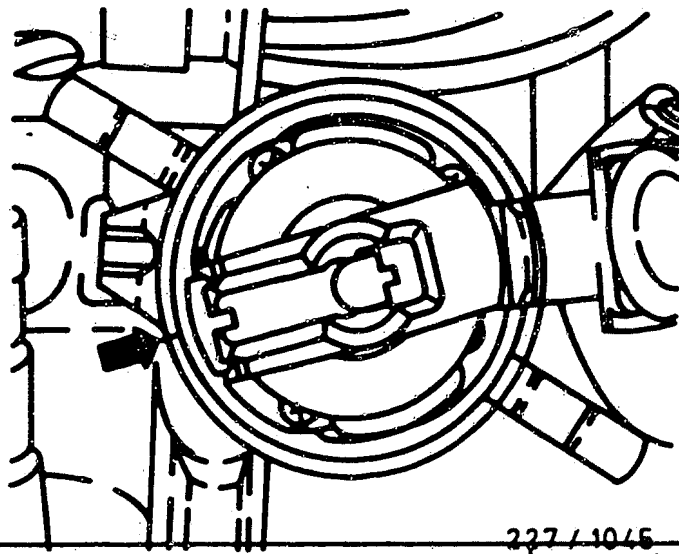
* carry out only when engine not running.



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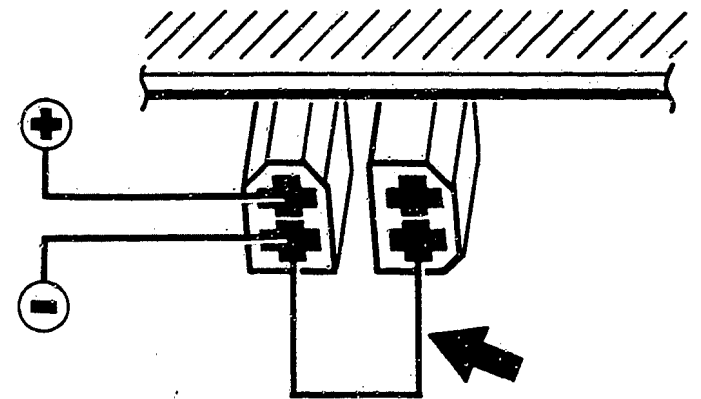
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RAPID DIAGNOSIS CHART (continued)

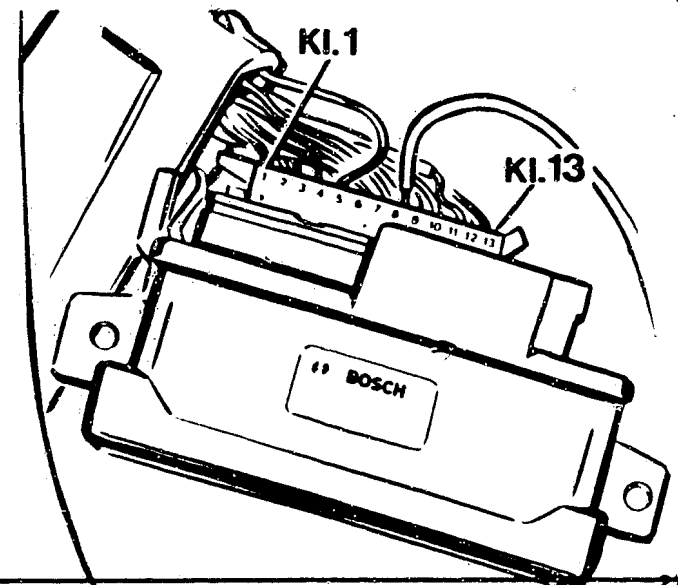
Test step	Testing of component/function Test instructions/conditions	Terminals	Set values
14	BASIC IGNITION SETTING Engine oil temperature min. 80°C Throttle valve in idle position. A/C switched off. Fault lamp must not flash. Jumper diagnosis plug connections with measurement lead (until completion of testing). See top picture, arrow. Engine idling. Note: setting $15 \pm 1^\circ$ BTDC See center picture, arrow.	—	13 - 17° BTDC
15	VOLTAGE SUPPLY, EI-K CONTROL UNIT Voltage, EI-K control-unit plug with handle cover removed. See bottom picture. Engine idling.	6 20 (+) (-)	12 - 14 V max. 2 V below U_B
16	VOLTAGE SUPPLY, IGNITION COIL Engine idling. Voltage, ignition coil and battery.	15 B- (+) (-)	equal to/greater than 10 V



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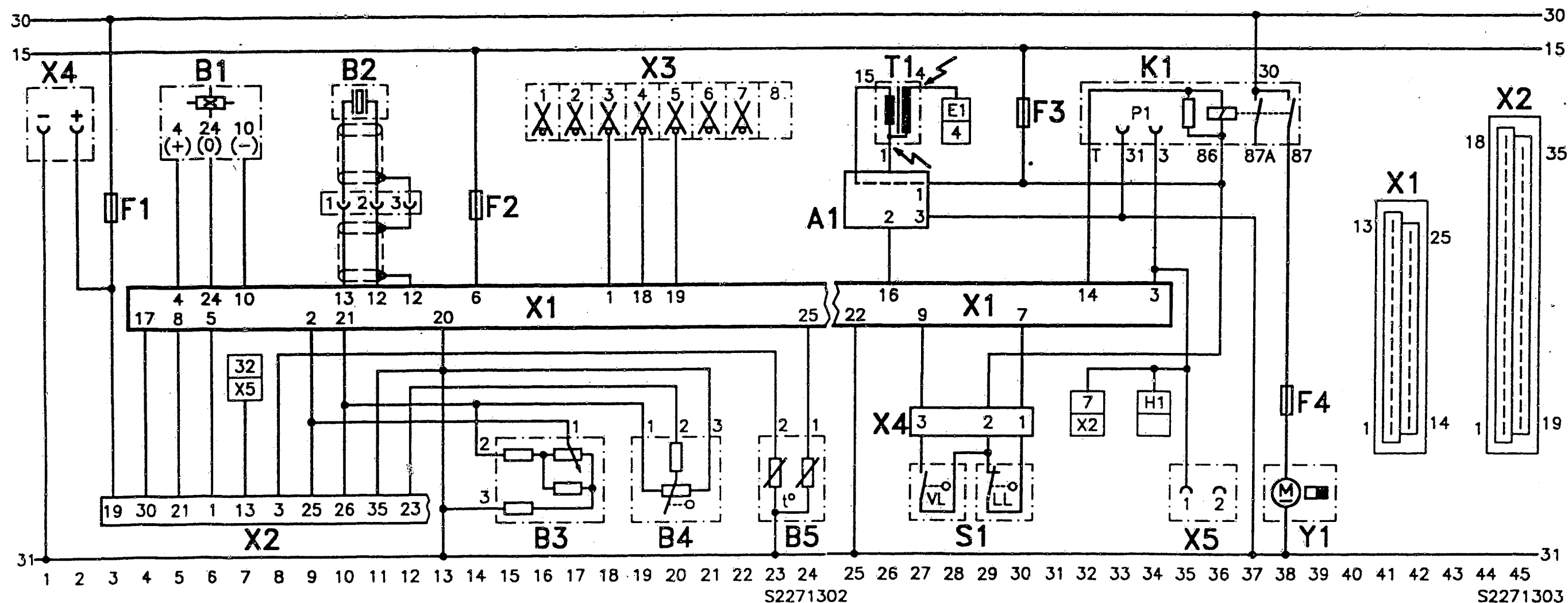
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TEST SPECIFICATIONS

Throttle-valve switch (idle) with ignition ON in idle position	approx. battery voltage
Feeler gauge between throttle-valve stop	0,5...0,7 mm 0 V
Throttle-valve switch (full load) Idle position	0 V
Throttle valve Open with ignition ON	68...76° approx. battery voltage
Knock sensor Tightening torque	15...25 Nm
Altitude sensor	
Sea level	3,2...4,7 V
500 m	2,8...4,0 V
1000 m	2,4...3,5 V
1500 m	2,0...3,0 V
2000 m	1,5...2,5 V
3000 m	0,8...1,6 V
Load signal with engine idling	0,2...4,6 V
Reference voltage for load and altitude sensor with ignition ON	4,5...5,1 V
Temperature sensor (coolant)	
+20° C	2,1...2,9 k Ω
+30° C	1,4...2,0 k Ω
+80° C	280...370 Ω
+90° C	210...280 Ω
+100° C	160...210 Ω
Ignition coil	
Primary (Bosch)	0,6... 1,0 Ω
Primary (Non-Bosch)	0,5... 1,5 Ω
Secondary (Bosch)	6,4...11,1 k Ω
Secondary (Non-Bosch)	5,0... 9,0 k Ω
Voltage supply EI-K control unit with ignition ON	Battery voltage
Voltage supply Magnetic pulse generator with ignition on	equal to/greater than 10 V

TEST SPECIFICATIONS (CONTINUED)

Magnetic-pulse-generator function at cranking speed	Rectangular pulse
EI-K control-unit function at cranking speed	Rectangular pulse
Voltage supply, trigger box with ignition ON	Battery voltage
Primary signal at cranking speed	Primary voltage/ engine-speed indication
Actuation, electric-fuel-pump relay with ignition ON	approx. 1 second (audible)
Contact resistance Supply leads, trigger box or primary circuit	max. 0,5 Ω
Ignition-distributor as-assembled setting	Cyl.1 TDC ID mark
Fault lamp Ignition ON with engine idling	Lights up OFF
Basic ignition setting Electric-fuel-pump relay jumpered Engine idling	13...17° BTDC (setting) 15 \pm 1° BTDC
Voltage supply EI-K control unit Engine idling	12...14 V max. 2 V below U _B
Voltage supply Ignition coil Engine idling	equal to/ greater than 10 V
Refer to SIS Microcard "Jetronic" or Autodata test specifications for settings as regards idle speed, exhaust emissions, valve clearance etc.	



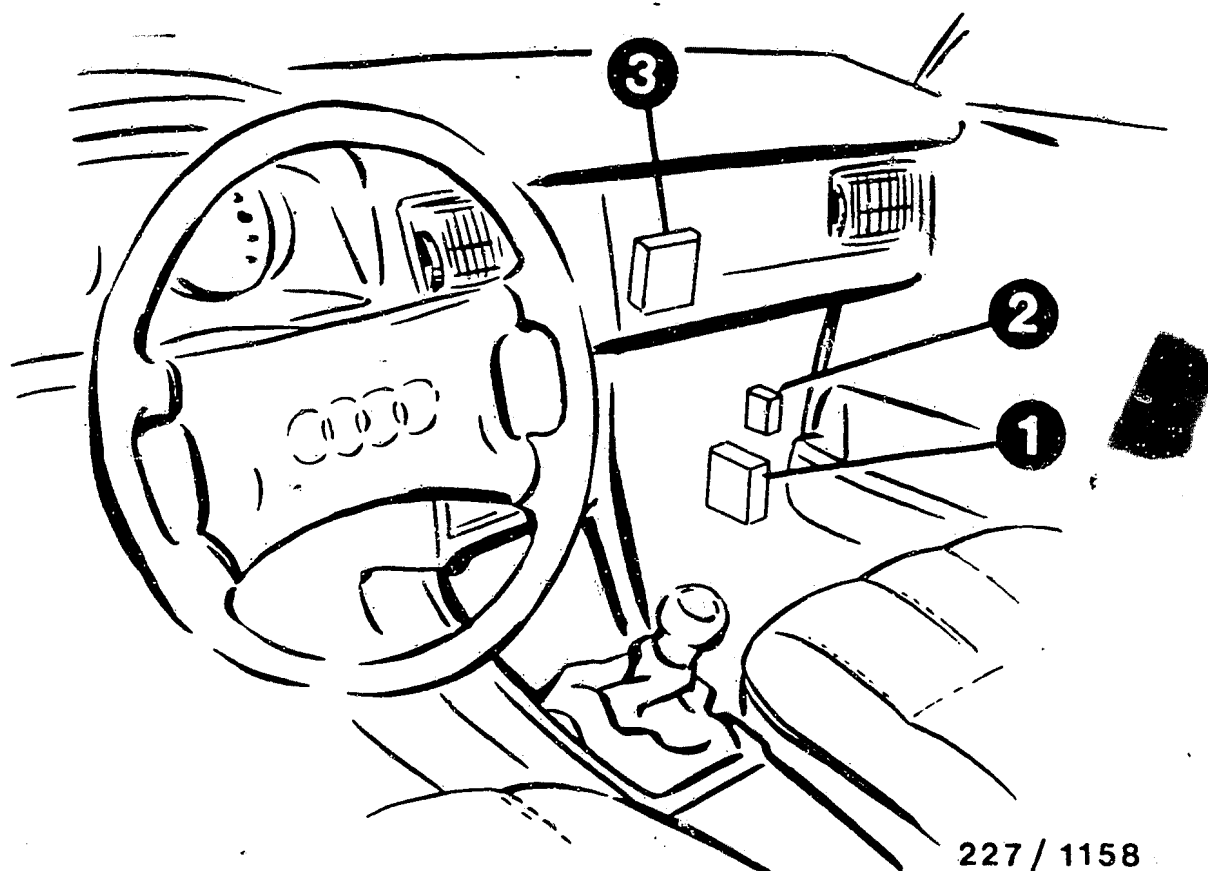
ELECTRICAL TERMINAL DIAGRAM

High-tension arrows: Caution 400 V...25 kV

A1 = Trigger box
 B1 = Magnetic pulse generator
 B2 = Knock sensor
 B3 = Altitude sensor
 B4 = Air-flow sensor (potentiometer)
 B5 = Temperature sensor (coolant)
 E1 = to ignition distributor

F1...4 = Fuses
 H1 = Fault lamp
 K1 = Electric-fuel-pump relay
 P1 = Contacts (previously diagnosis)
 S1 = Throttle-valve switch
 Idle/full load
 T1 = Ignition coil
 X1 = EI-K control-unit plug

X2 = KE-Jetronic control-unit plug
 X3 = Encoding plug
 X4 = Diagnosis plug connection
 X5 = Diagnosis plug connection (stimulation lead)
 Y1 = Electric fuel pump

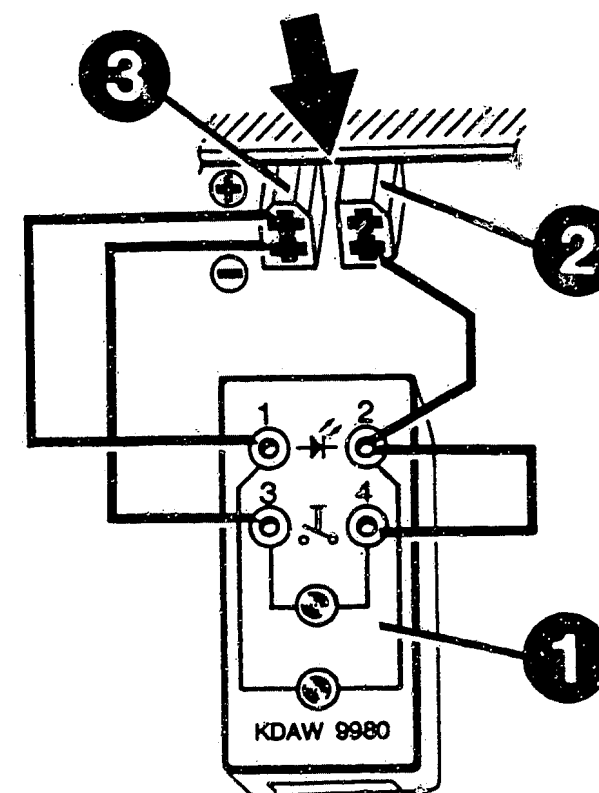


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- 1 = EI-K control unit
- 2 = Altitude sensor
- 3 = KE-Jetronic control unit

INSTALLATION POSITION OF COMPONENTS

- * EI-K control unit:
In passenger-side footwell (see picture).
- * Altitude sensor:
In passenger-side footwell above
EI-K control unit (see picture).
- * KE-Jetronic control unit:
In passenger-side footwell (see picture).
- * Variant encoding (if fitted):
on EI-K control unit.
- * Temperature sensor (coolant):
Next to spark plug, cyl. 1.
- * Throttle-valve switch (idle/full load):
On throttle-valve assembly.
- * Trigger box with ignition coil:
Next to battery.
- * Knock sensor:
In vicinity of left-hand engine mount.
- * Electric-fuel-pump relay:
In central-electrics console.
- * Fault lamp: in instrument cluster.



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- 1 = Evaluation unit KDAW 9980
- 2 = Diagnosis plug connection (* brown)
- 3 = Diagnosis plug connection (* black)

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

Diagnosis plug connections are located in the footwell (driver's side) in the recess behind the tray.

- * The colour may change.